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**Proceedings of Federal Waterways Management  
Research and Development Coordination Conference**

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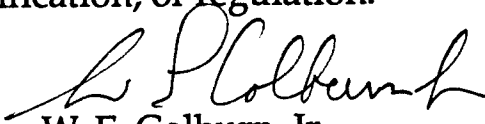
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## PREFACE

The report proceedings provide documentation of the Federal Waterways Management Research and Development Coordination Conference held 7-9 June 1994 at the Coast Guard Academy in New London, Connecticut. This conference was the second formal forum attended by multiple federal agencies to discuss their R&D activities pertaining to waterway management and navigation research.

This conference, which was coordinated by the U.S. Coast Guard Research and Development Center (USCG R&D), was attended by representatives from several federal agencies: U.S. Army Corps of Engineers (USACE), Maritime Administration (MARAD), U.S. Coast Guard (USCG), U.S. Coast Guard Academy (CGA), U.S. Navy (USN), National Ocean and Atmospheric Administration (NOAA), U.S. Transportation Command (USTRANSCOM), Military Traffic Management Command (MTMC), and Tennessee Valley Authority (TVA). The list of conference participants, with addresses and phone numbers, is provided in Appendix C.

Research and Development Topic Statements were organized into four Technical Sessions for presentation at the conference: Information Systems for Management, Facilities--Dredging and General, Information Systems for Navigation, Vessels/Equipment & Human Resources. All R&D Topic Statements are included in this report. Technical Session leaders also provided a summary of their sessions at the conclusion of the conference. Individuals who gave an overview of their perspective agency provided a summary of that presentation for these Proceedings.

Richard T. Walker, Senior Scientist, USCG R&D Center, was responsible for the overall direction of this conference. The conference steering committee (Appendix A) provided guidance in planning the conference and recommendations for the future. This report was compiled by Judith Rovins, Ph.D., President, The Motivators, and was edited by Richard T. Walker, USCG R&D Center.

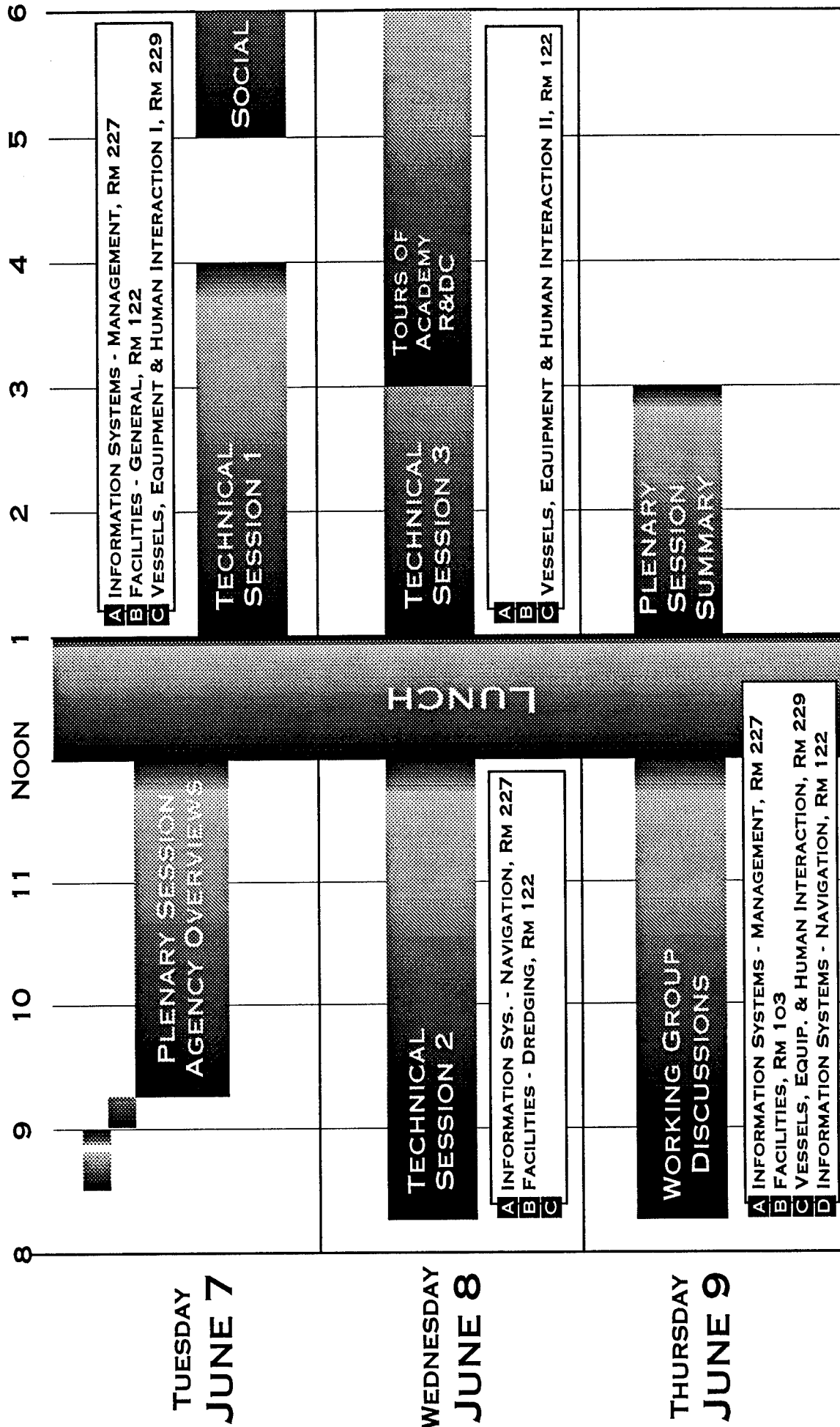
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# SECOND FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE



15 MINUTE BREAKS ARE SCHEDULED FOR THE PLENARY AND FOR TECHNICAL SESSIONS LASTING MORE THAN TWO HOURS.

## **FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE CALENDAR**

### **Tuesday, June 7, 1994**

0800-1600 0745	Conference Registration Open Buses leave Holiday Inn for Coast Guard Academy--Dimick Hall
0800	Coffee & Registration--Dimick Hall
0830-1145	Plenary Session: Welcome & Overview of Agencies' Responsibilities, Visions, Goals
0830	Ric Walker, Waterways Management Assessment Project Manager, Coast Guard Research & Development Center, Welcome & Conference Details
0845	Rear Admiral Versaw, Superintendent of Coast Guard Academy Opening Remarks
0900	Rear Admiral Ecker, Commandant (G-N) Office of Navigation Safety and Waterway Services, Welcome
0925	Dr. William E. Roper, Army Corps of Engineers, Director, Research & Development, Civil Works
0950	Mr. Paul Mentz, Maritime Administration Director, Office of Technology Assessment
1015	Break
1035	Mr. Andrew Del Collo, Naval Facilities Engineering Command, Assistant Director for Research & Development
1100	Dr. W. Stanley Wilson, National Ocean Service, NOAA Assistant Administrator, Ocean Services & Coastal Zone Management
1125	Admiral Ecker, Charge to the Participants
1145	Walk to Officers' Club
1200	Lunch, Officers' Club

**Tuesday, June 7, 1994 (cont'd)**

1300-1600      Technical Sessions, McAllister Hall

TECH 1A--INFORMATION SYSTEMS FOR MANAGEMENT  
(Room 227)  
TECH 1B--FACILITIES, GENERAL (Room 122)  
TECH 1C--VESSELS, EQUIPMENT, HUMAN INTERACTION  
(Room 229)

1430-1445      Break  
1600            Buses leave McAllister Hall to Holiday Inn

1715            Buses leave Holiday Inn to Officers' Club

1730            Icebreaker, Hors d'oeuvres and Cash Bar--Officers' Club

**Wednesday, June 8, 1994**

0800-1600      Conference Registration Open  
0745            Buses leave Holiday Inn to McAllister Hall

0800            Technical Sessions, McAllister Hall  
TECH SESSION 2A--INFORMATION SYSTEMS FOR NAVIGATION  
(Room 227)  
TECH SESSION 2B--FACILITIES, DREDGING (Room 122)

1015-1030      Break  
1200            Lunch, Officers' Club

1300            Technical Session, McAllister Hall  
TECH SESSION 3C--VESSELS, EQUIPMENT, HUMAN INTERACTION  
(Room 122)

1500-1900      Tour of Coast Guard Academy, R&D Center (Wear comfortable shoes)

1500            Group A--Computer Assistance Design (CAD) Lab (Room 115),  
Tow Tank (Room 111), Circulating Water Channel (Room 117),  
Electronic Engineering (EE) Lab--McAllister Hall

Group B--EE Lab, Circulating Water Channel (Room 117),  
Tow Tank (Room 111), CAD Lab (Room 115)--McAllister Hall

**Wednesday, June 8, 1994 (cont'd)**

- 1620 Lifesaving Museum, Waesche Hall
- 1630 20 people only--Interaction with SCANTS (Ship Control and Navigation Training Simulator), Radar Simulator (Yeaton Hall)
- 1700 First Bus leaves Waesche Hall to R&D Center--Branford House
- 1715 Second Bus leaves McAllister Hall to R&D Center--Branford House
- 1730 Hors d'oeuvres, Welcome by Captain J.R. Taylor
- 1800 Tour Advanced GPS, ECDIS Labs, Light Tunnel, etc.
- 1930 Buses leave R&D Center to Holiday Inn
- 2000 Dinner on your own

**Thursday, June 9, 1994**

- 0800-1600 Conference Registration Open  
0745 Buses leave Holiday Inn to McAllister Hall
- 0800 Working Groups: McAllister Hall
- INFORMATION SYSTEMS FOR MANAGEMENT (Room 227)  
INFORMATION SYSTEMS FOR NAVIGATION (Room 122)  
FACILITIES (Room 103)  
VESSELS, EQUIPMENT, HUMAN INTERACTION (Room 229)
- 1200 Lunch, Officers' Club
- 1300 Plenary Session: Summary -- Dimick Hall
- INFORMATION SYSTEMS FOR MANAGEMENT  
INFORMATION SYSTEMS FOR NAVIGATION  
FACILITIES  
VESSELS, EQUIPMENT, HUMAN INTERACTION
- 1500 Buses leave Dimick Hall to Holiday Inn

## **CONFERENCE SUMMARY**

### **Establishing Effective Research Partnerships in Government: Goal of Federal Waterways Management R&D Coordination Conference Hosted by U.S. Coast Guard Academy in New London, Connecticut, June 7-9, 1994**

"Waterways Management-A Partnership in Government" was the focus for the 2nd Federal Waterways R&D Coordination Conference held at the U.S. Coast Guard Academy in New London, CT, June 7-9, 1994. The conference was co-hosted by U.S. Coast Guard Headquarters' Office of Navigation Safety and Waterway Services and the Office of Engineering and Logistics support.

Rear Admiral P.E. Versaw, Superintendent of the Coast Guard Academy, opened the conference by welcoming the representatives of the Federal Agencies attending and by defining the focus of the conference: to identify the research goals and objectives of each agency, and the potential for collaboration on projects to improve the management and navigation on the nation's waterways. These waterways are important to marine transportation for commercial, military and recreational purposes. The safe, effective management and regulation of increasing traffic is a shared responsibility of many of the attending agencies. Rear Admiral Versaw emphasized to the conferees that the importance of the three day event was in the opportunity to improve the efficiency and effectiveness of research activities supporting the overall federal program of waterways management.

#### **Federal Agencies in attendance exchange information on research activities**

Along with the Coast Guard, the conference was co-sponsored by a number of Federal Agencies. During the course of the conference, representatives from these agencies presented overviews of their responsibilities and activities in navigation and waterways-related Research and Development. Agency presentations were given by Rear Admiral William J. Ecker, Chief, U.S. Coast Guard Office of Navigation Safety and Waterway Services; Dr. William E. Roper, Director of R&D, Civil Works for the U.S. Army Corps of Engineers; Mr. Paul Mentz, Director, Office of Technology Assessment for the Maritime Administration; Mr. Andrew Del Collo, Assistant Director for R&D, Naval Facilities Engineering Command, U.S. Navy; and Dr. W. Stanley Wilson, Assistant Administrator for Ocean Services & Coastal Zone Management, National Ocean Service/NOAA. Representatives from Military Traffic Management Command, Naval Command Control & Ocean Surveillance Center, Naval Surface Warfare Center, Volpe National Transportation Systems Center, U.S. Army Cold Regions Research Center, St. Lawrence Seaway Development Corporation, National Marine Fisheries Service, Tennessee Valley Authority, and the U.S. Air Force, also attended.

### **Rear Admiral Ecker encourages collaborative thinking**

It was noted that there are currently several ongoing interagency collaborations in the areas of surveying, electronic chart development, Electronic Chart Display and Information Systems (ECDIS), dredging and marine-related electronic bulletin board systems. Rear Admiral Ecker challenged the conference participants to continue this trend and identify collaborative research opportunities and approaches necessary to implement interagency efforts. During the conference, participants identified areas of common interest for R&D, issues that impede collaboration, and overall priorities for the systematic approach to waterways and navigation R&D.

During the three-day event, technical sessions focused on: Information Systems for Waterways Management; Information Systems for Navigation; Vessels, Equipment and Human Interaction; and Facilities and Dredging. These technical sessions featured brief presentations, or Topic Statements which summarized R&D projects underway or planned for the near future. These presentations were generally given by project managers or other staff directly involved with the work. To promote effective dialogue, the conference used a number of the Coast Guard's Total Quality Management Facilitators. These highly trained facilitators were able to help this group of diverse individuals identify specific R&D objectives and led discussions on strategies to achieve them. The facilitators were very effective in keeping people on track, and focused on the common goals identified in the discussions.

### **Conference participants tour U.S. Coast Guard facilities**

As part of the conference, participants toured the Coast Guard's Academy and R&D facilities. The tour served to broaden the perspective of other federal researchers on the Coast Guard's mission and related research facilities, and provided an opportunity to see how the facilities might function to support collaborative efforts. The tour included the Academy's Computer Assisted Design (CAD) Lab, Tow Tank, Circulating Water Channel, Electronic Engineering Lab, and Bridge and Radar Simulators. The tour continued at the Coast Guard Research & Development Center which is across the Thames River in Groton, CT. Tour stops included the Center's laboratories for Advanced Global Positioning System (AGPS), Electronic Chart Display and Information System (ECDIS), Advanced Communications, Vessel Traffic Service (VTS) and the Photometrics and the Light Tunnel.

### **Information Systems topic generates widest interest and indepth discussions**

With collaboration as the main theme of the conference, it is not surprising that Information Systems generated the most interest. Most of the agencies involved are developing information systems to support internal responsibilities in Waterways Management. The advent of ECDIS and the revitalization of the nation's VTS System highlight the need for thoughtful development of navigation information systems for the mariner. Attendees recognized that proper design of today's systems, with standard formats and common data dictionaries, will facilitate the linking of these systems for more comprehensive systems in the future. The creation of an electronic bulletin board system to support research and user dialogue in this area was discussed.

Other areas of common interest included the issue of Real Time Data such as that provided by NOAA's Physical Oceanography Real Time System (PORTS). This would be an essential component in the development of real time electronic charts. Considerable interest was also expressed in exploring further joint uses of Differential Global Positioning System (DGPS) technology. This is the enabling technology for real time precise navigation, and numerous other applications are inevitable.

**Participants agree on value of conference**

The representatives of the Federal Agencies attending were in agreement that the conference was an effective forum to promote interagency partnerships, utilizing the government's resources in a responsible, focused and coordinated manner. With expectations of continued cooperative efforts, next year's conference will be hosted by the National Oceanic and Atmospheric Administration in the Washington, D.C. area.



**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE  
JUNE 7, 1994**

**OPENING REMARKS BY RADM ECKER  
CHIEF, U.S. COAST GUARD OFFICE OF NAVIGATION SAFETY AND  
WATERWAY SERVICES**

**Overview—U.S. Coast Guard Program**

Good morning and welcome to the Coast Guard Academy and the second Federal Waterways R&D Coordination Conference. I also welcome you to the day-after the 50th Anniversary of D-Day. You history buffs will appreciate the efforts of our friends in the Maritime Administration and many others who helped ensure that some of the vessels that sailed the beaches of Normandy 50 years ago were restored and able to cross the Atlantic again to participate in this historical Anniversary celebration.

I would like to thank my former classmate and close friend, the Superintendent of the Coast Guard Academy, Rear Admiral Paul Versaw, for allowing us to use Academy facilities. This is a beautiful setting here in New London on the banks of the Thames River, and I hope you will avail yourselves of the time between conference sessions to walk about the Academy and enjoy the area.

This conference is being co-sponsored by the Coast Guard Office of Navigation and Waterway Services, and the Office of Engineering, Logistics and Development, home for our R&D Program. We will take advantage of this location to offer you tours of the laboratories and facilities here at the Academy, as well as those of the Coast Guard Research and Development Center and International Ice Patrol located just across the river in Groton, CT. In addition, tonight's activities include an Icebreaker Social at the Officer's Club where you will have the opportunity to enjoy the company of your fellow researchers in a relaxed atmosphere.

The purpose of this conference is to exchange information. Hopefully this will lead to better coordination of R&D projects related to waterways. We have over 70 presentations scheduled in the next three days. We will be using the same format as last year when this conference was hosted by Dr. Bill Roper and the Army Corps of Engineers at Fort Belvoir. These presentations will consist of project overviews in four general categories:

- Information Systems for Management
- Information Systems for Navigation
- Facilities (General and Dredging)
- Vessels, Equipment and Human Interaction

We have a full schedule, so I encourage the speakers to stay within the time limits. Each Session has two co-leaders, and one of their jobs is to give the hook to speakers who run on too long.

The conference theme is "Waterways Management - a Partnership in Government." This is most appropriate, given the Vice President's National Performance Review, and the Strategic Plans recently developed within the Coast Guard and the Department of Transportation. The process of reinventing government requires us to look for ways to do things differently, ways of working smarter, not necessarily harder. The marine mode of transportation is unique in that there are multiple government agencies with responsibilities relating to waterways. We must find the new paradigms for coordinating our efforts at the national level. In the lexicon of TQM, this should be an ongoing process, subject to continuous improvement.

The Department of Transportation has recently developed their Strategic Plan with seven Strategic Goals, a number of key objectives, along with projects and activities to achieve them. Goal 1, of particular relevance to this conference, is "Tie America Together" through an effective intermodal transportation system.

Other goals include:

- Invest in transportation infrastructure
- Promote safe and secure transportation
- Enhance the environment
- Put people first
- Empower DOT employees

And finally of additional interest to this conference:

- Create a new alliance between the nation's transportation and technology industries, to make them both more efficient and internationally competitive.

The Coast Guard has developed a Strategic Plan which flows from the National Performance Review and the DOT Strategic Plan. Our Commandant, Admiral Robert E. Kramek, outlined 8 goals to meet the challenges ahead. This conference directly supports his 6th goal which is:

- Engage the Coast Guard as an intermodal partner in the implementation of the DOT Strategic Plan, particularly in the areas of infrastructure and safety.

Within the Coast Guard, the Office of Navigation Safety and Waterway Services (G-N) administers seven Programs:

- Short Range Aids to Navigation
- Radio Aids to Navigation
- Bridges (over navigable waters)
- Recreational Boating Safety
- Ice Operations (domestic and polar)
- Vessel Traffic Services
- Search and Rescue
- Waterways Management

In order to execute these programs in a systematic and effective way, we have developed a Business Plan which supports the National Performance Review, the DOT and the Coast Guard Strategic Plans. The focus of the Waterways Management Program is to tie a number of other related Coast Guard programs together for effective management of the waterways in a systematic manner. This high-level approach is also desirable at the Federal agency level, and it is a goal of the G-N Business Plan to formulate, in concert with other agencies, an Interagency Waterways Management Committee.

This idea originated from last year's R&D Conference; that is to provide a forum for agency level discussions and building of consensus on waterways-related issues. We have invited the U.S. Army Corps of Engineers (USACE), the National Oceanic and Atmospheric Administration (NOAA), the Maritime Administration (MARAD), the U.S. Navy (USN), Minerals Management Service (MMS), the Military Traffic Management Command (MTMC), and the Environmental Protection Agency (EPA) to participate. Thus far we have held two Interagency Waterways Management Committee meetings, with another scheduled for August.

At this point I would like to say a word about the Coast Guard's Research and Development Program, a program designed to respond to the needs of those Coast Guard Program Managers who are responsible for executing waterways related missions. The objectives of the R&D Program are threefold:

- Identify and examine existing or impending problems in the Coast Guard's operational and regulatory programs and seek solutions based on scientific and technical advances;
- Remain abreast of the most recent advancements in science and technology, and pursue and undertake an aggressive program of applied research and development to adapt appropriate advancements to Coast Guard mission needs, concentrating on areas of interest where the potential for high payoff to Coast Guard programs, and increased quality and productivity exist;
- Carry out tests and evaluations in conjunction with this research and development in support of all Coast Guard programs to improve mission effectiveness and efficiency.

There are a number of R&D projects which currently support the Waterways Management Program.

Under the area of Marine Environmental Protection:

- Risk Assessment/Contingency Planning
- Remote Sensing/Spill Surveillance
- Vessel Salvage/On-scene Containment
- Spill Recovery Methods

In Marine Safety:

- Naval Architecture, Stability & Structures
- Human Factors, Minimum Manning, Training, Testing
- Human Factors Guidelines for Shipbuilding
- Ship Navigation Information Systems

In Aids to Navigation:

- Advanced GPS
- Short Range Aids to Navigation
- Vessel Traffic Services/Systems
- Waterways Safety/Traffic Management

And under Waterways Management Assessment:

- Traffic and Navigation Assessment
- Advanced Traffic Systems

As you can see, the Coast Guard is expending considerable effort to improve our ability to manage the waterways effectively, but we can't do it alone. The waterways are vital to this nation's economy and the National Transportation System, and all of you attending this conference are important as we work to "Tie America Together." So please reflect on the theme of this conference - "Waterways Management - A Partnership in Government."

I hope you will benefit from this conference. I hope you find the format stimulating, and that you will link up with several other people performing research which is of interest to you. It is my hope that this information exchange and the proceedings over the next three days will result in new and improved Government partnerships. We must work closely together as we strive to make this nation's waterways as safe, as efficient, and as environmentally friendly as possible.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE  
JUNE 7, 1994**

**OPENING REMARKS BY DR. WILLIAM E. ROPER  
DIRECTOR, RESEARCH & DEVELOPMENT, CIVIL WORKS  
U.S. ARMY CORPS OF ENGINEERS**

**Overview—Corps of Engineers Program**

In the vision for Navigation at the Corps of Engineers, we look to four major areas: 1) promote more efficient cost-effective waterways systems to move people and goods; 2) respond to economic and environmental changes; 3) ensure prior to construction the changes to the waterways system are economically and environmentally justified; 4) create a balance between conflicting user goals, keeping in mind the protection of the nation's waterways environment.

In support to the Army, DOD and the nation, the Army Corps provides professional timely engineering support, ensures waterways provide a means of moving military materials in a rapid cost-effective manner during deployment, responds to national emergencies, and works with other federal agencies for continued improvement of the waterways system.

We have a series of programs in the waterways management area to implement the vision. Navigation, flood control, R&D, and environment/emergency operations are the four areas. Within the system are 25,000 miles of waterways that we maintain and operate with over 2,160 dredges or other vessels. There are 102 major harbors and over 655 small harbors that we maintain. Over 34 percent of the nation's hydroelectric power is generated by Corps facilities with almost 300,000,000 acre feet of water storage.

We are involved in flood control as well as the environmental area where we issue approximately 10,000-11,000 wetland regulatory permits each year. In the area of water quality we work cooperatively with EPA, FWS, TVA, and a number of other agencies. On the Chesapeake Bay for example, we have developed for EPA numerical models to better understand water quality. Also, the Corps supports other agencies in superfund sites where contaminated material needs to be dredged and managed.

The Corps operates over 375 reservoirs, manages 18,000 square miles of land, and maintains over 14,000 recreational sites. During disasters we work closely with the Coast Guard and FEMA to support emergency needs. Under direct authority the Corps supports sandbagging efforts for emergency flood fighting, distribution of potable water, and clears debris for emergency access and area wide post event rebuilding.

## Research and Development

Our R&D program has both a Civil Works and a Military component. The 1994 budget is \$422,000,000. Within the Civil Works program we have four major research labs, Waterways Experiment Station in Vicksburg, MS, Cold Regions Research Laboratory in Hanover, NH, Construction Engineering Research Laboratory in Champaign, IL, Topographic Engineering Center at St. Belvoir, VA, and two R&D centers, the Hydrologic Engineering Center in Davis, CA., and the Institute for Water Resources at Fort Belvoir, VA. The scope of the Civil Works R&D program is broad, ranging from Materials through Environmental Quality, Coastal Engineering, Surveying and Remote Sensing.

Working with the Civil Works program, we identify Research and Development needs. To formulate a program we get input from tech-monitors representing organizations in headquarters, from practicing field engineer scientists, research program managers and from field review groups. We also involve the Civil Works R&D Review Committee, the Senior Managers at Headquarters. A detailed federal plan is developed, reviewed, and prioritized. Following the budget process the approved program is executed to develop the technology base to address the defined needs. Examples of some ongoing research include:

--Coastal Engineering--For improved understanding of the wave dynamics, sediment flows, and other characteristics of the coast. An example is our research facility at Duck, North Carolina where we collect basic data to better understand the fundamentals of coastal sediment transport.

--A multi-spectral directional wave generator at WES is used to improve model studies of coastal projects.

--Also important is our rip-rap test facility at WES for improving channel designs for protection from navigation wave and current forces.

--Since many of our facilities are over 50 years old, we have a research program addressing Repair, Evaluation, Maintenance, and Rehabilitation of water resource structures.

--The Wetland Research Program is looking at characterization, restoration, and stewardship of this important resource.

--Aquatic Plants--Particularly in the South and West, aquatic plants impact some of the navigation systems. We are looking not only at chemical and mechanical methods of controls but also biological control.

--Ice (Winter Navigation) -- In the upper parts of the U.S. winter navigation is restricted. We're looking at ways, such as high velocity bubblers, to reduce ice inflow into locks and allow extension of the navigation season.

--A new program in coastal inlets studies the dynamics of the interaction of outflows and inflows at inlets where over half of our coastal programs are located. Our research involves modeling, assessment of different breakwater designs and gaining a better understanding of the phenomena of inlets. We recently patented (worldwide) a new design for a concrete armament unit for use in breakwaters.

--We are completing the Dredging Research Program to make the dredging process more efficient. Our new dredging research will focus on dredging from an environment standpoint. For example, how do we dredge and also maintain Coastal Wetlands in Louisiana?

--Remote sensing is another high leverage area. We're examining some of the new sensors that NASA will be sending up in coordination with NOAA, the Coast Guard and others. We are researching how to use those effectively not only for land and water use planning, but also for oil spill identification and emergency response situations.

--Our Construction Productivity Advancement Research Program (CPAR) in its fifth year is a \$48,000,000 cost-shared program with the private sector. We have 96 industrial and university partners. Some of the recent spin-offs are composite materials for piling and waterfront structures, new kinds of concrete, and new software for better managing construction. This is a good program for the future, and has a lot of industry interest.

### **Cooperative Programs Resulting from Last Year's Conference**

--With NOAA we are demonstrating Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS), a laser system that very rapidly can survey the bottom topography from a helicopter flight station and give accurate, quick results that otherwise would be more costly and less timely.

--With NOAA we have an Oil Spill Cooperative project.

--Differential GPS, a tool to help in dredging, is being used with the Coast Guard to help instrument and improve the Mississippi River navigation system. We're also looking at differential GPS as a control sensor for an automated construction vehicle, under a CPAR project with Caterpillar, Inc.

### **Conclusion**

As we look to the future there will be increased pressure to reduce federal budgets, but also an increased need to be good environmental stewards. This will present new opportunities for partnering both within government and with the private sector. It will also encourage cost sharing, and the need for a higher return on our Research and Development investment.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE  
JUNE 7, 1994**

**OPENING REMARKS BY PAUL MENTZ, DIRECTOR  
OFFICE OF TECHNOLOGY ASSESSMENT, MARITIME ADMINISTRATION**

**Overview—Maritime Administration**

The Maritime Administration's responsibility is to provide basic transportation services for the citizens of the United States, both for domestic and foreign commerce. Our goal is to assure that adequate service is provided for all of the sectors of marine waterborne transportation. To do that, we work closely with the private sector providers of those services. In addition, the Maritime Administration operates a fleet of vessels, the Ready Reserve Force, to deploy in case of military/logistical requirements to overseas destinations. Our interests include ship and vessel design, construction, and operation in the context of overall transportation system requirements.

The U.S. maritime industry is at a crossroads. Ship design and construction capability focused on naval vessels during the eighties. Very few commercial vessels were built. That is all changing. Fewer naval combatants and naval auxiliaries will be constructed during the nineties. The challenge facing the U.S. maritime industry is whether design and construction capability can move back into the global commercial marketplace. To stimulate such a shift, the administration has embarked upon a national shipbuilding initiative. One element of that initiative is Maritech, a research and technology activity to assist the U.S. shipbuilding industry transition to the commercial marketplace. The Maritime Administration is very much involved with Maritech.

There are labor and management issues to be addressed if ship operators are to compete in the global marketplace. There have to be changes in the way U.S. ships are operated. There must be a more competitive cost structure. We have research activities which try to better understand the changes required. But, in the end, it will be the companies and the unions which decide whether to compete in the future under the U.S. flag.

A maritime revitalization package that was announced by Secretary Pena and Admiral Herberger about two months ago is now being considered by Congress. This package will allow some support for shipbuilding and ship operating companies, which in some way allows them to become more competitive in the international market. Those changes, whatever their final form, will have a significant effect on the activities of the Maritime Administration.

Ships must interact effectively with port and terminal facilities. For example, it is preposterous that APL C-10s are unable to arrive or depart fully loaded from the berth at the Oakland container terminal where the company is now quartered. Clearly, the dredging issues must be solved. This administration has taken a leadership role in bringing together a federal interagency task force headed by the Maritime Administration Deputy Administrator, Joan Yim, to better understand what needs to be done to correct this process.



We also have land side port access problems. In order to move cargo from the port, we rely on a very sophisticated intermodal distribution system in order to deliver commodities to consumers in a timely and cost effective way. This is a crucial area.

This administration has been very active in the R&D arena. There is another evolution of missions and goals that can be very important to all of us but which presents us with a challenge. In February 1993, the President issued a major report on technology. It was a call to put more effort into technology and to coordinate more with the private sector. Then in October, the President announced the formation of the National Science and Technology Council, chaired by the President's science advisor, Dr. Jack Gibbons, to coordinate Federal R&D across the board. Under the Science and Technology Council, a number of cross-cutting subcommittees were identified. There's a Committee on Transportation Research and Development, chaired by the D.O.T. Deputy Secretary Mort Downey. There are also committees on the Environment and Natural Resources, Information and Communication, Civilian Industrial Technology, International Science Engineering and Technology, and Health, Safety and Food.

The committee structure is even more complex. Within the Committee on Transportation R&D, for example, there's a subcommittee structure only recently begun to be implemented. A framework for assessing transportation research and technology, and opportunities was developed, and it has four major, cross-cutting areas: systems performance assessment, physical infrastructure, information infrastructure, and advanced vehicles. Since these research interest areas are cross-cutting, we're interested in all of them. One of the challenges is how we participate on so many committees with so few people.

We, at the Maritime Administration, are responding to the Secretary's Strategic Plan. One of the goals from that plan is to create a new alliance between the Nation's transportation and technology industries, to make them more efficient, and internationally competitive. The Maritime Administration's research and development program is specifically designed to meet the challenge and respond to the Secretary's direction. Basically, our R&D mission is to conduct technology activities related to the development and use of waterborne transportation systems for both commercial economic and national security purposes. In essence, we serve as a focal point to bring advanced expertise to bear on issues of concern to MARAD and DOT. We work closely with the U.S. Coast Guard as well as the other federal agencies. But, in the end it comes down to the people involved, it comes down to us. It comes down to all of us working together.

It's my firm belief that research and development, and technology innovation are really key to the future. It's crucial that we continue to strive to be world-class. I'm convinced that cost shared, joint venture R&D programs are effective. I would like to leave you with a quote from the D.O.T. strategic plan. We have to provide future generations with a transportation system that is safer, more environmentally responsible, and more efficient. We need to apply America's reserves of energy and ingenuity to ensure that our transportation system continues to serve our country's goals, and enhance the quality of life for our people in the years to come.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE  
JUNE 7, 1994**

**AGENCY OVERVIEW OF THE NAVAL FACILITIES ENGINEERING COMMAND  
BY ANDY DEL COLLO  
ASSISTANT DIRECTOR, RESEARCH & DEVELOPMENT**

**Overview—Naval Facilities Engineering Command**

Missions and Responsibilities

The Navy is primarily a user of Federal Waterways. Within the Navy, the Naval Facilities Engineering Command (NAVFAC) serves as the Navy's expert for facilities. It sets policy and provides a broad range of services in support of Naval waterfront facilities and for dredging done at Naval activities.

R&D Project Initiation

The process by which the Navy establishes R&D requirements and initiates R&D projects is undergoing significant change as the Navy seeks to increase the participation of Fleet commands in the setting of R&D priorities. Successful participation requires a sustained team effort involving end users, developing activities, program managers, and resource sponsors.

R&D Requirements

NAVFAC has four R&D requirements that are relevant to this conference: 1) Reduce the life-cycle costs of the Navy's waterfront infrastructure; 2) Improve the reliability of Navy mooring systems subject to severe weather conditions; 3) Determine the dredging needs for Naval activities that have had their missions realigned as part of the Base Realignment and Closure (BRAC) process; and 4) Reduce the cost to dredge areas with contaminated sediments.

R&D Project Execution

The management of Navy R&D project execution varies according to the phase of the project. Science and Technology efforts are managed by the Office of Naval Research. Demonstration and Validation efforts are managed by NAVFAC. Regardless of the phase, the simplest way to learn about and monitor Navy R&D is to work directly with the developing activity. They are encouraged to seek dual uses for their capabilities and products, and will be eager to keep you informed.

### Vision for Improved Dredging Coordination

NAVFAC envisions that the Navy would benefit significantly from increased dredging coordination between Navy activities and with other agencies. Increased coordination would provide a means of both understanding Navy-wide dredging costs and trends, and accelerating the introduction of cost saving strategies and technologies.

### Summary

Although the Navy's main interest in the Federal Waterways is as a user, NAVFAC is pleased to participate in this as well as future conferences. We hope that they will enable us to: a) share the results of our waterfront facility R&D; b) increase the use of Army COE dredging R&D products by Naval activities; and c) identify additional dual-use opportunities for other Navy R&D. Continued Waterways R&D coordination is important to NAVFAC and we will work to enhance it further.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE  
JUNE 7, 1994**

**OPENING REMARKS BY Dr. W. Stanley Wilson  
Assistant Administrator, National Ocean Service, NOAA**

**Overview—Partnerships in Marine Transportation**

Marine transportation is absolutely vital to the United States. The Global Positioning System, electronic charts, vessel traffic systems, hazardous spill prevention and response, and other developments will make substantial changes to many aspects in the near future. The constituency of this enterprise, however, is very dispersed. Managing these changes more effectively requires more coherence among all parties - federal, state, and local governments and the private sector. A goal for the federal agencies should be to define and develop an interagency strategy to support the marine transportation infrastructure. The strategy should provide a basis for coordinated agency budget submissions.

U.S. marine transportation is absolutely vital to the economy of the U.S. More than 98 percent, by weight, of U.S. international commerce outside North America moves by ship. Cargo worth nearly \$500 billion moves in and out of U.S. ports, generating 1.5 million U.S. jobs and contributing \$70 billion to the gross domestic product (GDP). Marine transportation is also vital for national defense.

We recognize a global economy today. Our foreign trade has grown from less than 10 percent of GDP in 1960 to more than 20 percent today. Some projections show that foreign trade will grow to over 30 percent by 2000 and nearly 50 percent by 2015. Shipping will be increasingly important.

Fully half of marine cargo today is oil or hazardous material. The costs of a serious accident today can be billions of dollars. The Oil Pollution Act of 1990 imposes a requirement for double hulls on tankers in U.S. waters at a cost of tens of billions of dollars. That Act has resulted in an investment in the Marine Spill Response Corporation of approximately \$400 million. The public must have confidence that shipping is safe and that the environment will be protected or it will prove difficult to accommodate future needs. We may be under investing in some of the most cost-effective techniques such as electronic charts.

There are well organized interest groups thinking about needs and working toward implementing the infrastructure that will ensure safe and efficient air and land transportation. There is no equivalent interest in the marine infrastructure.

**Federal Agency Roles and Interagency Fora**

NOAA, the Coast Guard, the Army Corps of Engineers, and the Maritime Administration have major roles in making the nation's marine transportation system work. NOAA provides navigation data and environmental information, and the nation's spatial reference system. The Coast Guard

enforces maritime laws, responds to accidents and maintains aids to navigation. The Corps of Engineers operates and maintains federal channels. The Maritime Administration administers programs to aid in the development, promotion, and operation of the U.S. merchant marine.

Several interagency groups have been formed recently to deal with issues related to marine transportation that span the interests of several agencies.

An Interagency Committee on Waterways Management has been proposed by the Coast Guard. The objective would be to exchange information and develop coordinated plans related to moving traffic safely and efficiently through U.S. waterways.

The Federal Interagency Working Group on the Dredging Process was convened by the Department of Transportation in the fall of 1993. Its mission is to review the existing dredging and disposal process and identify ways to improve the process. The Maritime Administration leads this effort which includes NOAA, the Coast Guard, the Corps of Engineers, as well as EPA and the Fish and Wildlife Service.

The Interagency Coordinating Committee on Transportation Research and Development has been formed as one of the nine committees under the new National Science and Technology Council. The Committee is charged with facilitating planning, communication, and coordination of federal R&D efforts, recommending priorities, and developing long-range plans. The Department of Transportation chairs the Committee.

The Federal Geographic Data Committee (FGDC) was formed under the auspices of OMB and earlier this year was charged by Executive Order with the coordination of the National Spatial Data Infrastructure (NSDI). The Department of the Interior chairs the FGDC. Transportation is recognized as a prime application for the NSDI. The Global Positioning System is its foundation. The Federal Geodetic Control Subcommittee, led by NOS, is charged with coordinating the development of a national network of differential GPS stations for navigation and positioning.

Professional meetings and other fora also address issues related to marine transportation. Our challenge is to knit these together into a coherent interagency strategy.

#### Marine Transportation Infrastructure Technologies

Many, if not most, of the technologies that will play a role in the infrastructure supporting safer and more efficient shipping are recognizable today.

Differential GPS is a basic element. The ability to simply and precisely determine a ship's location at sea is a revolutionary development and an enabling technology for all aspects of the infrastructure. The efforts of NOS together with these technology partnerships and the interagency efforts that are on-going are like pieces of a puzzle. We need an interagency strategy that puts them together in a coherent way. This strategy will help to guide our decisions, garner support, and ensure that the nation has the marine transportation infrastructure it needs.

# **TECHNICAL SESSION SUMMARY 1A: INFORMATION SYSTEMS FOR MANAGEMENT**

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**TECHNICAL SESSION SUMMARY:**  
**INFORMATION SYSTEMS FOR MANAGEMENT**  
by CDR David Smith (CGRDC) and Steve Scott (WES)

Four general topic areas were presented during Technical Session 1A: dredging information systems, navigation related database systems, predictive computer models or methods, and assessment of risks associated with waterways management. During a joint session of the technical sessions, opportunities for exchange of information and collaborative work were discussed.

**DREDGING RELATED TOPICS**

The dredging related presentations were concerned with instrumentation developed under the Dredging Research Program (DRP) of the U.S. Army Corps of Engineers. Two types of instrumentation packages were designed, fabricated and tested for measuring the migration of sediment from open water disposal sites. The Acoustic Re-suspension Measurement System (ARMS) and the PLUme Measurement System (PLUMES) were designed to measure migration of sediment mounds and suspended sediment plumes from disposal areas. The user of these systems would be U.S. Army Corps of Engineers (USACE) District operations personnel as well as dredging contract administrators. The information provided to the user would justify open water dredged material disposal sites and provide data for environmental regulatory compliance.

Two systems were described which monitor dredge processes while the dredge is working: Silent Inspector (SI) for Hopper Dredging Activities and Technology for Monitoring Dredge Hopper Loads. These systems were designed to produce dredge status reports utilizing output from sensors already installed on the dredge. The user of those systems would be the dredge operator and the USACE dredging contract administrator. These systems would potentially provide quality assurance of the dredging operation and reduce the number of on-site inspectors required for monitoring contractor performance.

An improved hydrographic survey method was presented by NOAA for reducing the number of passes required for complete bottom coverage during survey operations. The hydrographic survey system, designated as SeaBat-900I, consists of high resolution multibeam acoustic survey equipment designed for shallow water application. Potential applications include breakwater inspections and pre and post dredging surveys.

**DATABASE SYSTEMS**

Two relational database systems were presented. The **River Engineering and Environmental Geographic Information System (REEGIS)** database developed by the Lower Mississippi Valley Division (LMVD) of the U.S. Army Corps of Engineers was designed to access a wide variety of descriptive information about the Mississippi River system. The database provides data on information pertaining to river engineering, hydrographic surveys, and environmental criteria utilizing GIS information with a CADD interface. The database contains information for 1400

miles of the Mississippi River. The purpose of the database is to bring operations in the field to the user. Some of the descriptive information includes dike and revetment design, environmental studies and analysis, river engineering studies, electronic navigation chart data and the channel master plan.

The **Aid to Navigation Information System (ATONIS)** database developed by the U.S. Coast Guard describes approximately 100,000 federal and private aids to navigation. The current database is the third generation database. This version will be standardized in all ten Coast Guard Districts, extending down to the buoytender level with electronic updating capability. Additional management and reporting features have also been added. The upgraded database has several advantages. Accurate data entered by the buoy tender will be batch uploaded to the District database and used immediately for chart corrections and local notice to mariners. Because the database will be standardized over all the Districts, all of the District information can be periodically merged into one master data file for trend analysis and needs projections.

### **PREDICTIVE COMPUTER MODELS OR METHODS**

Four computer models were presented: water level and circulation prediction, computer aided mooring selection, the siting of oil spill equipment, and tracking cargo.

NOAA presented a personal computer based numerical model for **Water Level and Circulation Prediction** for navigation effects and spill monitoring. The model is to be used in conjunction with real time wind, water level, and current data from a system of stations along a coast to provide short-term forecasts of water level and current. The results of this research are real-time based forecasts of water level and currents made available through a variety of real-time information dissemination systems.

The computer aided **Mooring Selection program (MOORSEL)** is an information system developed by the Coast Guard for choosing the correct buoy mooring design for the selected location. The program calculates the length of chain, sinker size, and the watch circle radius for the user. The program considers forces acting on a buoy such as wind, wave motion, wind currents, and tidal currents. It is designed to run on a laptop computer with an intuitive interface for user friendly operation. This information system provides a more efficient method of mooring design, and potentially will replace the current design manual which is complex and time consuming to use.

The Coast Guard presented a personal computer based model for siting oil spill equipment, the **National Strike Force (NSF) Configuration Study**, is a decision support tool for determining spill response, exploring the equipment configuration required for a given spill, and exploring the trade-offs and deficiencies for different spill scenarios. The program essentially determines what equipment to use, where to stage it, and how to use it on scene. The decision model evaluates scenarios and risks associated with response to spills, selection of sites for pre-staging equipment and equipment to be purchased.



The U.S. Transportation Command presented methods for tracking the identity and location of cargo and equipment during large scale deployments such as Desert Storm. Cargo are present in three phases: in storage, in process, and in transit. Methods that are being investigated are the use of bar codes, laser optical cards, radio frequency, and satellite communications. Cargo containers or items can be closely tracked providing **In-Transit Visibility** to ensure delivery, security and optimum routing. Future uses of the tracking method are control over hazardous and sensitive cargo, control over environmental impacts such as spilled cargo, and to enhance vessel inspections.

### **RISK ASSESSMENT IN WATERWAYS MANAGEMENT**

The Coast Guard presented research directed to reducing the risk associated with marine transportation through improved waterway design and management. The goals of the research were to assess current aid to navigation systems to determine their effectiveness and to investigate systems and technologies to improve marine safety and efficiency. The products of this research effort are an information base and decision support systems for assisting the waterways management mission of the Coast Guard. Research areas include: traffic management, predicting future waterway users, user requirements for aids to navigation, and new aids to navigation. Future efforts will include methods for navigation risk assessment, measures of effectiveness, cost benefit analyses, and resource allocation.

### **COLLABORATIVE EFFORTS**

The following collaborations were discussed and the principle investigators were encouraged to seek out areas of mutual benefit:

Data sharing or exchange between REEGIS and ATONIS and REEGIS and MOORSEL.

NSF Configuration Study and other Oil Spill Response Programs access to information in the Water Level and Circulation Prediction model.

New hydrographic surveys possible by coupling multibeam sensor technology like SeaBat-9001 and the new dredging process monitors. monitors.

Data sharing or exchange between ARMS, PLUMES and hydrodynamic models like the Water Level and Circulation Prediction model.

Linking NSF Configuration planning and assessment with the Defense In-Transit technology for visibility of hazardous cargos and response equipment.

Risk Modeling: Involves Navy, USACE, USCG, MARAD, NOAA

Develop more sophisticated risk models by drawing on more accurate information on dredged channel (from dredge performance monitoring, ARMS, PLUMES and multibeam sensor mapping of the channel), water level and circulation models, accuracy of aids to navigation (ATONIS, MOORSEL), In-Transit tracking of cargos, configuration of spill response equipment, and overall measures of effectiveness. This allows management of the port and waterway, increasing traffic flow without reducing safety, and prioritizing shipping movements, dredging requirements and surveys.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS  
**PROJECT TITLE:** River Engineering and Environmental Geographic Information System  
(REEGIS)  
**PRINCIPAL R&D AREA:** Navigation

**PRINCIPAL INVESTIGATORS:**

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**NAME:** Ms. Lisa Benn  
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**PROJECT DESCRIPTION**

**Problem Statement:** Automation of various technical engineering, construction and project management aspects of the Middle and Lower Mississippi River Engineering Works.

**OBJECTIVE:** To create a comprehensive database with the capability to access all information concerning river engineering, hydrographic surveying, environmental, and related information.

**OVERVIEW/APPROACH:** Using Intergraph's Modular GIS Environment as the primary software platform and Intergraph's RISC workstations, the REEGIS schema was developed to meet the specific data management and analysis requirements such as archival of as-built or record drawings of river engineering structures, archival of hydrographic surveys, input of river data to ECDIS navigation charts for the Mississippi River, updating and reproduction of the Channel Improvement Master Plan for the Mississippi River, input of data to dike and revetment design programs, updating and reproduction of the Mississippi River navigation maps, production of hydrographic survey maps, endangered species habitat and population studies, and general river geomorphical, engineering, and ecological studies.

**IMPACT/PAYOFF:** The REEGIS schema will result in a "seamless" yet district-separated database encompassing river engineering and environmental information for St. Louis, Memphis, Vicksburg and New Orleans Districts to implement and aid river works, environmental impact studies, and management projects.

**PROGRESS TO DATE:** The REEGIS schema has been created and distributed to all districts presently involved. Data input and attribution work have begun under each district's jurisdiction.

**FUTURE PLANS:** The REEGIS database is expected to come to fruition by Spring of 1996 at which time it will be updated yearly.

**PRODUCTS:** N/A

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 92

**EXPECTED COMPLETION:** FY 96

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENTS"**  
**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Acoustic Resuspension Measurement System (ARMS)

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

**NAME:** Mr. E. Clark McNair, Jr.  
Manager, Dredging Research  
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US Army Engineer Waterways Experiment Station  
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**PHONE:** (601) 634-2070 **FAX:** (601) 634-4253

**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Until recently, technology was not sufficient to obtain in situ measurements of sediment entrainment and bottom response (erosion or accretion) at dredged material placement sites. Such information is necessary to ascertain whether open water disposal sites are dispersive or nondispersive, and to assist in determining the useful life of such sites. It is necessary to know whether disposed materials will migrate from the designated sites onto sensitive biological regions, or remain within the confines of the site. Advances in the field of high-frequency acoustics made possible the development of an Acoustic Resuspension Measurement System (ARMS) which uses sound frequencies allowing direct observation of fluid and sediment motion to within 0.1 cm per sec.

**OBJECTIVE:** Recent advances in high-speed, low-power integrated electronics enables ARMS and its controlling circuitry to be combined in a compact, battery-powered package. ARMS is contained in a relatively small pressure housing and mounted unobtrusively on a bottom-standing tripod. ARMS will characterize fluid motion and sediment transport properties for site designation and monitoring.

**OVERVIEW/APPROACH:** ARMS is an instrument for measuring sediment resuspension and movement in the water column at existing and proposed dredged material open water disposal sites. It is an integrated ensemble of specialized underwater sensors designed to accurately measure in-situ properties of the bottom boundary layer. Seven components that comprise ARMS include an acoustic sediment concentration profilometer, four acoustic velocity sensors, a pressure gage, a thermistor, a thermistorometer, a multi-frequency sediment particle sizer, and an optional video camera. Data from ARMS are processed with onboard processing circuitry, and the resulting complete data sets are sent via serial line to a streaming tape drive for mass storage.

**IMPACT/PAYOFF:** ARMS can be deployed at sites up to 30 m deep, and the inherent stability of the tripod makes lowering the system a straightforward procedure. It is optimal to place ARMS on a flat bottom that is clear of large debris.

**PROGRESS TO DATE:** ARMS is completely developed, was tested in open water as part of a dredging project, and proved to be highly accurate and reliable.

**FUTURE PLANS:** ARMS is available for immediate turnkey use by Corps field offices.

**PRODUCTS:** ARMS is a remote sensing instrument for measuring sediment resuspension and movement in the water column at existing and proposed dredged material open water disposal sites.

van Evra, R.E. III and Bedford, K.W., 1992, "Acoustic Resuspension Measurement System (ARMS): Announcement and Availability," Dredging Research Technical Notes DRP-1-05, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** PLUme Measurement System (PLUMES)

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Suspended sediment clouds or plumes develop in open water both at the site of dredging operations and at dredged material placement areas. Environmental concerns often require an assessment by direct monitoring, numerical modeling, or both, of the extent, movement, and longevity of suspended sediment plumes. Typical environmental questions to be answered are whether suspended sediments leave the placement site, where the material goes, and how much material remains in the water column after a certain time.

**OBJECTIVE:** PLUme Measurement System (PLUMES) is a remote sensing method to measure fluid velocities and suspended sediment concentrations of material at dredging or disposal sites. The acoustic sensor makes unobtrusive wide-area measurements of the water column velocity and sediment concentration in the water column.

**OVERVIEW/APPROACH:** PLUMES samples adjacent water volumes on the order of square meters over depths as great as 100 m or more. This type of wide-area synoptic sampling cannot be accomplished with bottle samplers or water pumpout systems. Real-time display of the data allows tracking of suspended sediment clouds even when they are not visible from the water surface.

**IMPACT/PAYOFF:** PLUMES has been used to document to resource agencies that suspended sediments from dredge disposal operations were not transported to environmentally sensitive biological regions. This allowed the continued use of already designated open water disposal sites off Miami, Tampa, Fernandina, and Canaveral, Florida. At least \$ 55 million were saved by not having to conduct extensive environmental studies related to designation of new disposal sites at these locations.

**PROGRESS TO DATE:** PLUMES is completely developed, and has been fully proven in real-world applications.

**FUTURE PLANS:** PLUMES is available for immediate turnkey use by Corps field offices.

**PRODUCT:** PLUMES is a remote sensing instrument for measuring fluid velocities and suspended sediment concentrations of material at dredging or disposal sites.

Thevenot, M.M., Prickett, T.L., and Kraus, N.C., 1992, "Tylers Beach, Virginia, Dredged Material Plume Monitoring Project, 27 September to 4 October 1991," Technical Report DRP-92-7, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Kraus, N.C. and Thevenot, M., 1992, "The PLUme MEasurement System (PLUMES): First Announcement," Dredging Research Technical Notes DRP-1-06, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94



**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Silent Inspector (SI) for Hopper Dredging Activities

**PRINCIPAL R&D AREA:** Dredging, Operations, Database Management Inspection

**PRINCIPAL INVESTIGATOR:**

**NAME:** Mr. E. Clark McNair, Jr.

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The Corps depends almost completely on inspectors for quality control and performance monitoring of contract dredging. Collecting accurate, unbiased information during dredging operations is becoming increasingly important in verifying compliance with project plans, especially regarding the removal and placement of contaminated sediments. Automated inspection tools, referred to as "silent inspectors" are one way to assist inspectors, reduce the cost of responding to claims, and make dredge production records more accessible, understandable, and usable. An effective automated dredge monitoring system can provide unbiased information to all parties involved in dredging activities.

**OBJECTIVE:** The Silent Inspector (SI) system design consists of a set of standards, functional descriptions, and software to satisfy specific requirements, including: use existing sensors; focus initially on hopper dredges and dump scows with future expansion to include other types of dredges; require neither additional personnel nor extensive training of existing personnel to use; and produce data products which are useful for managing existing and future Corps dredging projects.

**OVERVIEW/APPROACH:** The primary output of SI will be a series of dredge data summary reports. SI will produce widely used reports such as trip, load, and job reports automatically. Trip reports will itemize time spent by the dredge performing each part of the dredging cycle, including documentation of positions with time, and start and stop times for each dredging operation. Load reports will describe the amount of material in the dredge hopper. Job reports will combine trip report summary information with production and cost data. The job report is thus useful for planning, budgeting, and cost estimating of future projects. This information also becomes a data source for bid abstract information. Included in the job report will be dredge pay quantities based on predredging and postdredging surveys.

**IMPACT/PAYOFF:** Benefits of the SI include it being a common data base for resolution of claims. It also will provide resource agencies with pertinent knowledge regarding the precise locations at which disposal operations were initiated and finished, thus precluding early dumping or imprecise placement of dredged materials of various characteristics.

**PROGRESS TO DATE:** Silent Inspector t (SI) design, construction, deployment, and prototype hopper dredge testing and system verification has been conducted.

**FUTURE PLANS:** Private industries are expected to develop and market their own systems that comply with Corps SI specifications, and SI technology will be gradually integrated into Corps operations and contracting procedures.

**PRODUCT:** An automated SI system for collecting accurate, unbiased information during hopper dredging operations.

Rosati, J. III, 1990, "Dredge Operations Silent Inspector System (DOSIS)--An Automated Aid for Dredge Operations Inspection," Dredging Research Information Exchange Bulletin, Vol. DRP-90-4, pp. 1-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** VESSELS/EQUIPMENT

**PROJECT TITLE:** Technology for Monitoring Dredge Hopper Loads

**PRINCIPAL R&D AREA:** Dredging and Automation

**PRINCIPAL INVESTIGATOR:**

**NAME:** Stephen H. Scott

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The calculation of production for a hopper dredge depends on numerous variables such as the volume of dredged material in the hopper, the amount of residual bin water in the hopper before the load is taken, the total displacement of the dredge during the loading process, the density of the water in the project area, and the density of the in-situ sediments being dredged. Dredge operators/managers need an automated system for calculating dredge production based on realtime measurements of hopper volume and dredge displacement.

**OBJECTIVE:** Test and evaluate instrumentation for providing realtime data on hopper volumes and dredge displacements, and develop a data acquisition/computer interface for recording dredge process data and automatically calculating dredge production for each hopper load.

**OVERVIEW/APPROACH:** Acoustic sensors and pressure sensors were tested in the laboratory and in the field for measuring changes in hopper volume and dredge displacement. Full scale tests were performed on the Corps of Engineers dredge WHEELER. Additional dredge processes such as the production meter output (slurry density and velocity) and hopper door relays were incorporated into the design to facilitate automation. An automated system was designed and implemented, using a personal computer for data acquisition and realtime hopper load calculation.

**IMPACT/PAYOFF:** The automated system eliminates the need for manual observation of bin water volumes and hand-calculation of production. The system stores raw sensor data on the hard disk of the computer, and automatically produces a production report describing hopper volume and displacement before and after the load is taken.

**PROGRESS TO DATE:** The project will be completed in FY 94. The automated system is currently installed on the dredge WHEELER.

**FUTURE PLANS:** The final report will be published at the end of FY 94 under the Dredging Research Program.

**PRODUCTS:** Numerous Technical Notes and Dredging Research Bulletins have been published on the automated system under the Dredging Research Program (DRP) at WES.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 89

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**TOPIC STATEMENT**

**TOPIC AREA:** INFORMATION SYSTEMS

**PROJECT TITLE:** Navigation Business Information Interface with Present Databases

**PRINCIPAL R&D AREA:** Automation, Database Management, Navigation, Decision Support

**PRINCIPAL INVESTIGATOR:**

**NAME:** David E. Lichy

**ADDRESS:** WRSC, Navigation Data Center  
Casey Building , 7701 Telegraph Road  
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**PHONE:** (703) 355-3052

**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** As the Corps Navigation Operations function evolves to a project management organization, it requires new and easy to use management tools at the project site. Future cost efficiency and program effectiveness will depend upon the managerial knowledge and ability of the project manager. The O&M community presently collects numerous amounts of operational data. Unfortunately these data systems were originally designed as collection and central processing information systems for investment analysis and national level policy decision making. The business operations of the O&M community need to have easy access to multi-functional data at all organizational levels.

**OBJECTIVE:** To provide site managers with access to management information via automation technology.

**OVERVIEW/APPROACH:** NDC through this initiative is designing and testing users' interface with existing navigation data systems to provide management and performance measurement information. The interface is graphical, mouse and windows designed with time and geographical roll-up dimensions linking independent databases.

**IMPACT/PAYOFF:** The end results will eliminate numerous data calls, duplication of effort of combining multi-database information and provide access to all data at all levels in the organization .

**PROGRESS TO DATE:** Database linkages have been reviewed and prototype interface developed.

**FUTURE PLANS:** Complete prototyping and field system nationwide.

**PRODUCTS:** Online data interface and users manuals.

**START DATE:** FY 1993

**EXPECTED COMPLETION:** FY 1996

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Impact and Implementation of the National Performance Review (NPR) and the Government Performance and Results Act (GPRA) of 1993

**PRINCIPAL R&D AREA:** (include all that apply)

**PRINCIPAL INVESTIGATOR:**

**NAME:** David E. Lichy

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The NPR & GPRA define a new way of doing business in the federal government. These changes need to be addressed and an implementation developed.

**OBJECTIVE:** To develop an analysis and implementation plan which successfully implements the intentions of NPR & GPRA 1993.

**OVERVIEW/APPROACH:** Form a field task group to analyze the provision of the NPR & GPRA and propose an implementation process.

**IMPACT/PAYOFF:** The implementation should provide for improved organizational effectiveness and efficiency in completing our navigation mission.

**PROGRESS TO DATE:** Field teams have formed.

**FUTURE PLANS:** Develop a report of implementation.

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**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Water Level and Circulation Prediction

**PRINCIPAL R&D AREA:** Navigation, Decision Support, Dredging, Operations, Data Services,  
Maneuvering

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**OBJECTIVE/ BENEFITS:** Water levels and current information are important for safe and efficient navigation. Tide and tidal current predictions alone are not adequate in areas where meteorological effects on water level and currents are important. Real-time water level and current measurements have provided more accurate information to the maritime community, but accurate short-term forecasts are really required. This research deals with the use of real-time wind, water level, current, and other data from a system of stations along a coast along with numerical hydrodynamics and weather forecast models to provide short term forecasts of water level and currents. This information will be disseminated via various real-time systems such as PORTS or the National Water Level Observation Network.

Tidal prediction itself still requires improvements. Present hardcopy methods for providing tide and tidal current predictions (i.e. tables and charts) have accuracy problems resulting from constraints caused by the hardcopy format. This research and development is aimed at designing and producing digital tidal prediction products that are not only easier to use and have better spatial coverage, but are also more accurate.

**PROGRESS TO DATE:** Three forecasting projects were begun last year: (1) the Coastal Forecast System (CFS) East Coast feasibility study, in which a numerical model for the entire East Coast of the U.S. is being driven by forecast winds from the NWS eta model; (2) a water level forecasting project for Chesapeake Bay; and (3) a water level forecasting project for Tampa Bay. In addition, work has begun on a digital tide and tidal current prediction product for San Francisco Bay.

**FUTURE PLANS:** These four projects will continue for some time.

**PRODUCTS:** Expected results are the provision of real-time based forecasts of water level and currents made available through a variety of real-time information dissemination systems.

**PROJECT START DATE:** FY 1993 **EXPECTED COMPLETION DATE:** Ongoing

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**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Waterways Management Assessment

**PRINCIPAL R&D AREA:** Decision Support, Risk Analysis, Human Factors

**PRINCIPAL INVESTIGATOR:**

**NAME:** Richard Walker

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:**

Marine vessel accidents continue to occur in our coastal waters, frequently resulting in loss of life, property, and environmental damage. The policies, methods of implementation and infrastructure associated with the current waterways management practices are not adequate to minimize vessel accidents and their consequences. Additionally, the decision support tools used to measure the effectiveness of proposed changes in waterways, and management approaches either do not exist or are inadequate.

**OBJECTIVE:** Reduce the risk associated with marine transportation through improved waterways management. Investigate marine navigation issues and technologies that may improve waterway design and overall management of the waterways. Evaluate effectiveness of current port and harbor short range and electronic AtoN systems. Investigate and develop the management tools to assess alternative waterway designs and to determine the optimum mix of technologies and systems required to improve marine safety and port efficiency while reducing operating costs. Review existing Coast Guard information systems and investigate how they may be integrated for improved waterways management. Investigate advanced concepts for vessel traffic management.

**IMPACT/PAYOFF:** Improved Waterways Management resulting in reduced risk of accidents (decreased loss of life, property and environmental damage) and increased efficiency (greater throughput) of our nation's waterways.

**PROGRESS TO DATE:** Established a General Working Agreement with the DOT/Volpe National Transportation Systems Center. Developed a plan which should result in a Decision Support System to be used in the Benefit/Cost Analyses necessary for evaluating changes in the Aids to Navigation system mix for a given waterway. Completed Baseline Analyses in 3 areas: 1) Waterways Management, 2) Waterway Users and 3) Navigation Risk Assessment.



**FUTURE PLANS:** Complete Baseline analysis for 4) Effectiveness & Benefits (of Waterway changes): Analyze User Requirements for AtoN and project future needs based on new technology in Nav aids (DGPS, ECDIS). Develop Decision Support Tool for use in evaluating alternative aid/waterway configurations.

**PRODUCTS:** (reports, publications, inventions)

May ' 94	Interim Reports/Baseline Analyses Topics 1-3
Oct ' 94	Interim Report/Baseline Analysis Topic 4
4 QTR 95	User Requirements Analysis Report
FY 98	Decision Support Tool for Configuration Assessment

**OTHER AGENCIES INVOLVED:**

This work is being executed by RSPA/Volpe National Transportation Systems Center. Also holding initial discussions with NOAA/Sea Grant to cooperate in developing Navigation Risk Assessment model at Sea Grant University (MIT).

**START DATE:** FY 93

**EXPECTED COMPLETION:** FY 98

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS-MANAGEMENT

**PROJECT TITLE:** Operational Testing of SeaBat-9001 for Hydrographic Surveys

**PRINCIPAL R&D AREA:** Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:**

This is an existing and projected continuing need for shallow water hydrographic surveys with greater accuracy and with more complete bottom coverage than can be achieved with current single beam acoustic depth sounders.

**OBJECTIVE:** The objective is to combine shallow water multibeam hydrographic surveying with backscatter imagery. The combined data set is expected to be more readily suited for increased levels of editing automation. The goal is to reduce the number of soundings/swaths which the hydrographer must review and to increase the confidence that those rejections performed via automated algorithms are valid.

**IMPACT/PAYOFFS:** A major impediment to increased production with multibeam hydrographic surveys tools is the inability to process the large volume spatially dense data sets in a timely manner.

**PROGRESS TO DATE:** C&GS has completed testing of a short-range multibeam sonar and placed it into operational status for least depth determination. The effort leading to this point has required approximately 2 years and 4 staff years.

**FUTURE PLANS:** Modify the operational multibeam sonar hardware and procedures to provide backscatter imaging followed by a test/demonstration.

**PRODUCTS:** (Reports, publications, inventions)

**START DATE:** August 1992 **EXPECTED COMPLETION:** August 1994

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CONFERENCE  
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Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS-MANAGEMENT

**PROJECT TITLE:** NSF Configuration Study

**PRINCIPAL R&D AREA:** Response Equipment, Risk Analysis, Training

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Develop an interactive configuration system to ensure that increased equipment resources available to the U.S. Coast Guard for response to oil spills will be adequate.

**OBJECTIVE:** Develop a model which will be a desktop, computer based, interactive analysis model to use to answer questions concerning the purchase and siting of equipment resources for oil spills. The model will be capable of analyzing equipment needs for large spills, small spills, or even analyzing the needs and requirements of distributing one type of equipment.

**IMPACT/PAYOFF:** During the next few years equipment resources for response to oil spills will increase significantly. The Coast Guard has and will purchase new equipment and store it at strategic locations throughout the United States. The Marine Spill Response Cooperative has selected 19 sites throughout the United States for the storage of cleanup equipment that could be called upon by the Coast Guard for response to a major spill. In addition to this equipment, State and local oil spill cooperatives will be purchasing equipment to combat oil spills in their areas. Although there will be significantly increased equipment resources available to the Coast Guard for response to oil spills, several questions must be answered to insure that these capabilities will be adequate to respond to major oil spills.

**PROGRESS TO DATE:** Final version of prototype system will be delivered in July 1994.

**PRODUCTS:** (reports, publications, inventions)

Final report July 1994 with model

**FUTURE PLANS:** Demonstrate the use of the system at a response exercise. First demonstration scheduled for New Orleans, December 1994.

**START DATE:** 1992 **EXPECTED COMPLETION:** July 1994

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**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Computer-Aided Mooring Selection

**PRINCIPAL R&D AREA:** Navigation, Automation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The optimum design of buoy moorings is a very difficult task. The effects of wind, waves, currents and bottom conditions must be considered. The parameters of the design vary with each buoy hull type (and there are over 70 in the current U.S. Coast Guard inventory) and every location. The U.S. Coast Guard's Aids to Navigation Technical Manual, COMDTINST 16500.3A, provides recommended mooring hardware for most buoy hull types. Determining the proper length of the mooring is the hardest part of the problem. Too short of a mooring and the buoy drags off-station or breaks away in a storm. Too long of a mooring and the large watch circle radius may put the buoy out of tolerance. Ideally, the mooring would be just long enough to hold during severe conditions, and no more.

To aid in the task of mooring design, a manual was published to the U.S. Coast Guard's Aid to Navigation community in 1978, called the Buoy Mooring Selection Guide for Chain Moorings. The manual is cumbersome and time consuming to use. To determine proper chain scope and sinker size, the users must consult at least eight of the manual's 267 graphs and tables. In addition, not all buoy hulls are included in the manual, and the manual only permits users to design moorings of one chain type (no bridles, chafe chain, or bottom chain). Rather than consult with the manual, Coast Guard units typically use rules of thumb for various moorings.

**OBJECTIVE:** The objective of the work conducted by the U.S. Coast Guard Research and Development Center was to develop a computer program for use by the U.S. Coast Guard's Aid to Navigation units that will automatically design minimum watch circle radius buoy moorings for specified environmental conditions, chain and buoy hull types.

**IMPACT/PAYOFF:** The current version of the MOORSEL program is applicable to roughly 15,000 of the Coast Guard's 25,000 floating aids. Previous studies done by the U.S. Coast Guard found that about 10% of the floating aids are reported as off-station annually due to weather conditions. If MOORSEL serves to reduce this percentage of discrepant buoys by only 1%, the annual savings could be \$150,000 or more.

**PROGRESS TO DATE:** The United States Coast Guard has developed a computer-aided mooring selection guide (MOORSEL) to improve speed and accuracy in selecting aids-to-navigation buoy moorings. This interactive tool allows the buoy tender's crew to use a sophisticated numerical simulation in designing reliable buoy moorings. MOORSEL considers the effects of wind, waves, current, water depth, and bottom type. Design parameters are specified by the user through a menu-driven "pick-list". The program calculates the minimum required length of chain needed for a reliable mooring, the size of the sinker, the watch circle radius and mooring's factor of safety. The results are displayed with a graphical plot of the mooring's underwater geometry. MOORSEL also features automated advisories to the user, such as a warning if the buoy has insufficient freeboard or could drag off station.

MOORSEL has been validated with technical recommendations from the International Association of Lighthouse Authorities (IALA) and tested on buoy tenders.

**FUTURE PLANS:** The MOORSEL program will be available for use throughout the U.S. Coast Guard in late 1994.

**PRODUCTS:** Mooring Selection computer program and User Manual

**OTHER AGENCIES INVOLVED:** National Data Buoy Center

**START DATE:** October 1989      **EXPECTED COMPLETION:** July 1994

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**TOPIC STATEMENT**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Aid to Navigation Information System (ATONIS)

**PRINCIPAL R&D AREA:** Navigation, Automation, Database Management, Management Analysis

**PRINCIPAL INVESTIGATOR:**

**NAME:** LT Joseph P. Sargent: Project Manager  
Short Range ATON Research

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The U.S. Coast Guard's Aid to Navigation Information System (ATONIS), developed under the ReQuest™ database software, is no longer supported under the Coast Guard's Standard Workstation contract and is inefficient as it is unique to each Coast Guard District and relies on form mailings for system updating.

**OBJECTIVE:** The U.S. Coast Guard is developing a new database system under the support PROGRESS™ database software to maintain information regarding approximately 100,000 federal and private aids to navigation. The new ATONIS will be standardized in all 10 individual Coast Guard Districts and will extend down to the buoytender level with electronic updating capability. Many new management and reporting features, including automated formatting of the Local Notice to Mariners sections, have been identified for incorporation to ATONIS.

**IMPACT/PAYOFF:** The ATONIS upgrade is expected to tremendously increase the record keeping and reporting efficiency throughout the ATON community. Accurate data entered by the buoytender personnel will be batch uploaded to the District database and used immediately for chart corrections and Local Notice to Mariners. As the ATONIS will be truly standardized across all Districts, no retraining upon personnel transfer will be necessary. Lastly, the standardization will be useful at the Coast Guard Headquarters level as all district information may be periodically merged into a single master file and used for trend analysis and needs projections.

**PROGRESS TO DATE:** The PROGRESS™ ATONIS database development is near completion and is undergoing field testing at the First Coast Guard District in Boston, MA and at two field units in the New England area. The prototype has been quick to attain the full confidence of the three test sites.

**FUTURE PLANS:** Transfer of the system to the the CG Headquarters program manager is scheduled for 1 July 1994. Full implementation in the field will occur during FY 95.

**PRODUCTS:** Aids to Navigation Information System database program, User Manual, and system documentation.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** December 1991      **EXPECTED COMPLETION:** July 1994

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**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS

**PROJECT TITLE:** Defense In-Transit Visibility (ITV)

**PRINCIPAL R&D AREA:** Automated Identification Technologies (AIT)

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Develop seamless ITV capability providing movement location and detail information for Defense cargo, passengers, forces, and patients during peace and war.

**OBJECTIVE:** Increase efficiency and effectiveness of Defense Transportation.

**OVERVIEW/APPROACH:** Develop, enhance, and integrate worldwide information systems (Defense and commercial) to include the utilization of AIT. To focus such an undertaking USTRANSCOM is developing a Defense ITV Integration Plan. Plan identifies high-level requirements while providing an overview of operational concepts and an implementation schedule required to develop a robust ITV capability.

**IMPACT/PAYOFF:** Benefits derived include improved in-the-box visibility, contingency response times, inventory management, and increased opportunities to interact and exchange information with outside agencies and commercial carriers.

**PROGRESS TO DATE:** USTRANSCOM continues to test and evaluate different AIT applications. Testing has been conducted in diverse scenarios such as the Somalia peacekeeping efforts and the Korean Patriot missile movement. Upon completing assessment, USTRANSCOM will recommend DOD standard transportation technologies for the Office of the Secretary of Defense approval. Additionally, an operational prototype of the Global Transportation Network (GTN) is available today providing visibility of USTRANSCOM managed lift asset and associated cargo/passengers placed aboard lift assets.

**FUTURE PLANS:** USTRANSCOM plans to expand visibility capabilities by capturing AIT generated information. All future movement information will be gathered and maintained through an operational GTN. GTN's initial operational capability will be in Feb 97 and final operational capability is scheduled for Jan 00.



**PRODUCTS:** Technologies reviewed include bar coding, laser optical cards, radio frequency tags, and satellite tracking.

**OTHER AGENCIES INVOLVED:** DOD involvement includes the Office of the Secretary of Defense, Joint Staff, Unified Commands, Services and DLA.

**START DATE:** Mar 93      **EXPECTED COMPLETION:** Jan 00

## TECHNICAL SUMMARY 1B: FACILITIES—GENERAL

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## **TECHNICAL SESSION SUMMARY: FACILITIES**

**by Andrew Del Collo (NAVFAC) and Carl Huval (WES)**

A total of 30 R&D topic statements had been prepared in the FACILITIES segment of the conference, and 21 of these topics were presented during the conference during the two sessions.

### **Dredging - Budgeting**

The operations and maintenance of Corps of Engineers projects are a significant part of the total agency costs. Management information system tools are being developed to provide budget analysis capability to assist the decision making process. Data base software has been applied to give spreadsheet and graphical analysis for summarizing maintenance dredging. A risk-based approach to navigation channel sedimentation provides a measure of project reliability.

### **Dredging - Methods**

The dredging research program (DRP) of the Corps of Engineers has investigated new dredging technologies and sponsored R&D to implement the equipment for operational use. Modifications for eductors (jet pumps) were designed, built, and tested in the laboratory and the field. Reports on this study have been published. Design guidance has been developed to improve the performance of fluidizer systems based on laboratory and field tests. The results of this R&D have been published. Field demonstrations of water injection dredging technology have been accomplished and test results published.

### **Dredging - Disposal**

The construction and maintenance of navigation channels in waterways usually involve dredging; the disposal of dredged material is of major concern from an operational and environmental viewpoint. Management and modelling tools have been developed as a part of the DRP research program to help the project designers and operators. PC-based models of dredged material movement at open water sites are available and documented in published reports. The models require information on waves, tides, currents, and sediment properties, as well as proposed disposal site conditions for use. Laboratory testing has been used to verify the models.

As a part of the DRP research studies, several instrument measurement systems have been developed to improve the capability of determining channel bottom material properties. A point load test system providing rock strength data was verified in field and laboratory applications. The instrument system is available for application and reports documenting that the techniques have been published. A drilling parameter recorder has also been deployed which is connected to a standard drill rig and used to give channel bottom dredging material properties. Acoustic and seismic systems have been developed to help characterize bottom and sub-bottom material properties.

### **Waterways - Navigation**

The design of new ports and harbors or modifications to channels (improvements by deepening or widening) requires that studies be conducted to evaluate the navigation impacts of the proposed changes. Development and application of numerical models, scale models, and

prototype studies are being used to determine the effects of changes and to help in project designs. A finite element harbor oscillation model is being applied to study the impacts from ocean wave penetration. The model accounts for wave diffraction, reflection, and transformation. The model is available for application and has been documented in several WES/CERC reports. A general research study using small craft models is underway to improve design criteria for shallow draft port design. The major thrust of this effort is to determine small craft response from wave action in the typical entrance channel leading into a port area. A mathematical model of ship response is also being applied to entrance channel depth design. This effort is in conjunction with the Corps of Engineers, WES Ship Simulator. The Navy is applying similar models to aircraft carrier entrance channel transits into ports such as San Diego. Navigation problems at field sites can be investigated using video recording of vessel movement; techniques are being developed to evaluate and process the data leading to possible remedial measures to reduce or cure adverse navigation conditions.

### **Navigation - River Training**

The Corps of Engineers uses a number of types of structures such as dikes, weirs and other river training structures to control and deepen the main waterway channels. Research studies are underway to improve the training structure effectiveness and reduce dredging volumes and project costs. A major new R&D program in ice engineering has recently been initiated to develop methods of reducing the impacts from ice jams in ice-prone rivers. Physical model studies have been used to improve design criteria for bendway weirs. Many site-specific model studies have been conducted over the years at WES; future plans include a continuing role for scale model research using moveable-bed models.

### **Navigation - Structures**

Structural problems occur on many of the Corps of Engineers' hydraulic structures on the waterways. Research is underway to develop techniques to investigate gate vibration problems induced by flowing water. Scale model studies, including the structural/vibration response, are being used to develop improved gate design and to improve finite element numerical models of vibration response. The repair and rehabilitation of waterway concrete structures are of major concern, especially where concrete deterioration has occurred. Several promising new materials are being researched for use in concrete repair, such as use of precast concrete, rather than cast-in-place. Finite element structural modeling is being used to research stresses, including thermal-induced concrete cracking.

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**Topic Statement**

**TOPIC AREA:** FACILITIES

**PROJECT TITLE:** "Numerical Modeling of Harbor Response in Waves"

**PRINCIPAL R&D AREA:** Construction Planning, Rehabilitation, Navigation, Management  
Analysis, Port Operations, Harbor Design

**PRINCIPAL INVESTIGATOR:**

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Ms. Lori L. Hadley

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The design of new harbors or modification to existing facilities requires that studies be conducted to determine the consequences of the changes. Oscillations induced by waves that exist outside the harbor may cause difficulties navigating particular portions of the harbor and may limit vessel types or hinder cargo transfer. Appropriate choices of harbor protection plans and facilities placement may serve to damp harbor resonance and allow operations under a greater variety of incident wave conditions.

**OBJECTIVES:** Initial harbor designs and modifications can be tested using physical and numerical models. Both methods of investigation are appropriate for certain applications and expected prototype conditions. Construction and running of physical models are very expensive and limit the number of alternatives that can be tested. Though numerical models also have limitations, they are easily modified and, if properly calibrated, allow the investigation of a large number of alternative designs at very little additional cost. The objective is to develop and apply an accurate, flexible numerical model for the evaluation of harbor oscillation and resonance.

**OVERVIEW/APPROACH:** A numerical harbor oscillation model has been developed by the Waterways Experiment Station, Coastal Engineering Research Center. The model is based on linear wave theory and is applicable to harbors of arbitrary size, shape, and depth specified on a finite element grid. The model accounts for the processes of diffraction, reflection, and wave transformation over a variable-depth bottom.

**IMPACT/PAYOFF:** The application of a highly adaptable numerical model will allow evaluation of many harbor design alternatives at considerable cost savings. The numerical model will allow selection of the most promising designs that can then be tested using a small number of physical

Miller, et. al., Harbor

models. Numerical model results are also used for selecting instrument placement locations in prototype measurement programs.

**PROGRESS TO DATE:** The numerical model described above has been developed and applied to many harbor design situations in the mainland U.S. and in Hawaii.

**FUTURE PLANS:** The present model has limitations which make it less accurate or unsuitable for some applications. Nonlinear processes such as wave breaking and overtopping, and transmission past harbor walls are not included. The present model also does not account for wave-current interactions. A new work unit, to begin in October 1994, will be directed at removing most of these limitations. The numerical solution procedure will also be modified to allow application to much larger areas than are presently practical. In addition to the wave process and numerical improvements, the new model will provide substantial graphical capabilities which will greatly facilitate grid generation and visualization of results. The present version of HARBD will continue to be used until the new release.

**PRODUCTS:** The present model, HARBD, is available from the Coastal Engineering Research Center. Support is provided only for Corps users. Several publications are available describing the model and some recent applications. The most recent, "Numerical Modeling of Harbor Response to Waves," by Dr. E. F. Thompson and Ms. L. L. Hadley, will be published in the next issue of the *Journal of Coastal Research*.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** Upgrades to the HARBD model will be started in October 1994 and are scheduled to be completed by October 1996.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Application of Decision Support Systems to O&M Budget Management

**PRINCIPAL R&D AREA:** Decision Support, Management Analysis, and  
Database Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION: PROBLEM STATEMENT:** Methods are needed for providing budget data analysis capability during the U.S. Army Corps of Engineers'(USACE) budget formulation process. Presently, there are approximately 20,000 work functions that require funding through the O&M budget process. Each work function must be assigned a rank for funding priority. Various funding "scenarios" must be considered because of funding constraints. These scenarios involve determining which work functions will or will not be funded if funds are cut or not available. A personal computer based decision support system (DSS) is needed for providing the analysis capability.

**OBJECTIVE:** To develop a personal computer based DSS for analyzing O&M budget data.

**OVERVIEW/APPROACH:** A DSS was developed for providing budget analysis capability. Discussions were held with operations managers at Headquarters, U.S. Army Corps of Engineers and the Corps field offices concerning the budget process. A personal computer based DSS written in RBASE software was developed to assist in the decision making process. The DSS provides a method for ranking work functions, provides financial analysis capability, and provides a method for conducting funding scenario analyses.

**IMPACT/PAYOFF:** The budget DSS provides the USACE with the capability to better evaluate the impact of funding constraints or cuts on the O&M budget. It provides comprehensive analysis capability on a personal computer, thus eliminating the costs of using a mainframe computer.

**PROGRESS TO DATE:** The project will be completed in FY 94. The prototype system has been developed for Headquarters, U.S. Army Corps of Engineers and currently is being implemented in the field offices.

Scott, DSS

**FUTURE PLANS:** The final report detailing the DSS will be written the end of FY 94.

**PRODUCTS:** A DSS written in RBASE database software for budget analysis.

**OTHER AGENCIES INVOLVED:** U.S. Army Construction Engineering Research Laboratory (CERL) and Institute for Water Resources (IWR)

**START DATE:** FY 91

**EXPECTED COMPLETION:** FY 94



**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** FACILITIES

**PROJECT TITLE:** Cost Trend Analysis for Water Resource Projects

**PRINCIPAL R&D AREA:** Decision Support, Management Analysis, and  
Database Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Methods are needed for determining expenditure trends of projects or classes of projects. Project managers need a tool for analyzing historical expenditure data and extracting expenditure trends in the form of summary reports and graphical analysis.

**OBJECTIVE:** To investigate methods of analyzing expenditure data through database decision support systems.

**OVERVIEW/APPROACH:** An expenditure trend decision support system (DSS) was developed under the Improvement of Operations Management Techniques Research Program (IOMT) to analyze project operations and maintenance expenditures for the Corps of Engineers. Project expenditure data are uploaded to Headquarters, U.S. Army Corps of Engineers (HQUSACE) from the Division and District offices during the O&M budget formulation process. The data is stored on a mainframe computer database at HQUSACE. The decision support software is written in DBASE database software. It is designed to provide summary reports and graphical expenditure trends by Division, District, project, and project class. Analysis options available from the DSS include accounting for increasing trends due to inflation, analysis of operations and maintenance expenditure trends separately or combined, and project expenditure trends as a percent of total operations or maintenance expenditures. Graphical analysis options include pie charts, bar charts, XY charts, and capability for multiple XY charts.

**IMPACT/PAYOFF:** The expenditure trend DSS provides a tool for project managers to track expenditure trends of a broad range of projects or project classes. The prototype system is designed for HQUSACE application, i.e., the review of all Division and District expenditure data. The DSS can be modified for specific applications involving expenditure data analysis with a more narrow scope. This system potentially provides management with the capability to better evaluate the cost/benefit characteristics of a project as well as provide a tool for justifying budget decisions.

Scott, Cost

**PROGRESS TO DATE:** The project will be completed in FY 94. The prototype system has been developed and will be evaluated by HQUSACE.

**FUTURE PLANS:** The final report detailing the DSS will be written the end of FY 94.

**PRODUCTS:** A prototype cost trend DSS resident on a personal computer.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 91

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**TOPIC STATEMENT**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Navy Waterfront Structures Technology Development

**PRINCIPAL R&D AREA:** Construction, Rehabilitation, Non-destructive Evaluation, Condition Assessment, High Durability Marine Concrete

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION:** Under sponsorship of the Office of Naval Research, the National Facilities Engineering Service Center is developing technology to enhance the Navy's ability to assess safe load capacity of waterfront structures; to design repairs to reinforced concrete structures to provide >20 years life in an inter tidal environment and to construct waterfront structures having 50 to 75 years of service life.

**PROGRESS TO DATE:** NFESC has coupled the impact load method with finite element modeling technology and demonstrated feasibility of rapid and direct assessment of load capacity of pier and wharf docks. Long term durability tests at worldwide sites have led to knowledge of performance of concrete additives and Debar surface treatments in providing highly durable marine concrete. Ongoing research is identifying mechanisms which led to early failure of repairs to reinforced concrete structures in a marine environment, and is investigating performance of selected repair concepts. Additional research is resolving technical issues relative to ductility, quality assurance and durability that hinder use of composite materials in waterfront structural applications.

**FUTURE PLANS:** The impact load method diagnostics system will be used in demonstration assessments of safe capacity of selected piers at NAVSTA Norfolk during FYs 94 and 95. NFESC is working with ASTM to develop a new specification for epoxy coated Debar for use in severe marine environments. During FYs 94 and 95, NFESC will develop and test composite components for upgrade of pier structural capacity. Subscale and 1/2 scale tests will be performed at the NFESC Advanced Waterfront Technology Test Bed located in the Port of Hueneme, CA. NFESC will investigate corrosion cell transference, shrinkage and chloride/moisture content aspects of failure mechanisms of repaired concrete structures during FYs 94 and 95. During FYs 94-97, NFESC will investigate performance of chloride ion removal processes, sacrificial cathodic protection using embedded anodes and impressed current cathodic protection concepts for extending life of repaired concrete structures.

Springston, Navy Waterfront

**PRODUCTS:** Impact Load Method Diagnostic System Pier Upgrade Concepts Criteria for Repair of Reinforced Concrete Structures in an Inter-tidal Environment Epoxy Coated Rebar ASTM Specification

**OTHER AGENCIES INVOLVED:**

U.S. Army Construction Engineering Research Laboratory

Composites Institute of Society of Plastics Industry

U.C. Berkeley

U.C. Santa Barbara

U.C. Davis

Pacific Gas & Electric

Lankard Materials Laboratory

**START DATE:** In progress

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**TOPIC STATEMENT**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** River Confluence Ice Program

**PRINCIPAL R&D AREA:** Ice, Navigation, and Operations

**PRINCIPAL INVESTIGATORS:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** River confluences in the northern tier of the U.S. are common sites for ice jams at spring breakup. These jams slow down or altogether suspend navigation, often result in extensive damages at fleeting and mooring areas, plus loss of towboats and barges. They also cause severe damages to riverine structures, such as river training structures and bank stabilizing riprap, and can lead to flooding. The Corps of Engineers has initiated a \$4.5M, 5-year R&D program, the River Confluence Ice Program (RCIP), to develop techniques and strategies to mitigate ice problems at confluences.

**OBJECTIVE:** It is not possible nor economically justifiable to eliminate ice problems at river confluences. The objective of the program is to develop methods to predict the probability of the occurrence and of the severity of ice accumulations, and operational, structural and non-structural techniques to reduce the severity and frequency of ice events at confluences.

**OVERVIEW/APPROACH:** Four technical work units will address the various aspects of the RCIP, namely:

1. Prediction of probability of ice events: perform a statistical analysis of past ice events, their severity and the conditions leading to them (AFDD, discharge, warming trend, rainfall); Develop an algorithm to predict the probability of occurrence and the severity of future events on the basis of this analysis, existing late winter ice conditions and weather forecast.
2. Structural mitigation techniques: adapt existing structural ice control methods to the conditions specific to river confluences; develop a selection methodology,
3. Non-structural mitigation techniques: adapt such existing ice control methods to the conditions specific to river confluences; develop a selection methodology.

Carey, Tatinclaux, Ice

4. Effects of project operations: for the case when flow control projects exist upstream and/or downstream from a confluence, determine the operation parameters to either assist in ice control or ensure that project operations do not worsen ice conditions.

5. Effects of channel modifications: determine those channel modifications that may decrease or increase the severity of ice problems at confluences to either apply them as possible ice control or prevent negative impact.

**PROGRESS TO DATE:** Program started in FY 94, with funding available only in second quarter.

**FUTURE WORK:** Select representative river confluences. Conduct site visits. Historical data gathering and literature search.

**PRODUCTS:** ETLs, new EM or new chapters to existing EMs.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 94

**EXPECTED COMPLETION:** FY 99

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Hydraulic Design of Bendway Weirs

**PRINCIPAL R&D AREA:** Dredging, Construction, Control, and Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** On several of the navigable rivers within the U.S., a number of the bendways are experiencing encroachment of the point bar into the navigation channel.

**OBJECTIVE:** The objective of this research is to develop design guidance for bendway weirs to widen and stabilize the low-water navigation channel in bendways.

**OVERVIEW/APPROACH:** A physical movable-bed model study is being conducted to determine the appropriate design parameters for general application of bendway weir on navigable streams.

**IMPACT/PAYOFF:** This will reduce maintenance dredging costs and in delays to the towing industry in navigating constricted bendways, improve the navigation conditions, and the degree of safety associated with the bendway.

**PROGRESS TO DATE:** Prototype bendway analysis was completed, the test reach was constructed, and model adjustment tests were initiated.

**FUTURE PLANS:** Tests will be conducted to determine the sensitivity of whirl spacing, angle, height, and length. Once these parameters are established bendways with different radii and degrees of curvature will be tested.

**PRODUCTS:** Results of this work will be incorporated in an update of Layout and Design of Shallow-draft Waterways USACE Engineering Manual, published in a WES technical report, and presented in a workshop for potential users.

**START DATE:** FY 92

**EXPECTED COMPLETION:** FY 96

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA:** FACILITIES

**PROJECT TITLE:** Shallow-Draft Coastal Port Design (Phase II)

**PRINCIPAL R&D AREA:** Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Current guidance for shallow-draft coastal port design is based on general "rules of thumb" and the navigation criteria developed for deep-draft channels. Small craft have their own unique requirements for safe navigation, and these requirements need to be reflected in the design criteria. The designing engineer now relies on local navigation experience and ambiguous guidance in the selection of a harbor plan. The result is a variety of designs with port performance ranging from inadequate to grossly over designed. A critical need exists for a systematic approach to shallow-draft port design that is based on the actual requirements of small craft.

**OBJECTIVE:** To develop improved shallow-draft coastal harbor and navigation channel design criteria.

**OVERVIEW/APPROACH:** Typical design vessels for shallow-draft coastal port design were selected. Model data were collected in initial tests to determine vessel maneuvering characteristics in waves using an existing 1:50-scale vessel and a "typical harbor". A 1:20-scale vessel is being used to conduct tests with varying environmental and operating conditions. A second and third design vessel will be selected and the initial tests will be repeated. Therefore the effect of vessel size, lines, and appenditures and maneuverability on the port design can be determined. Work will be coordinated with Phase I to conduct a Shallow-Draft Coastal Port Design training course. Prototype maneuvering data will be obtained when possible in conjunction with project studies to provide verification data.

**IMPACT/PAYOFF:** This research project will improve the design guidance for commercial shallow-draft coastal ports which will reduce the cost of construction, improvement, and maintenance and improve the safety of navigation within those ports.

**PROGRESS TO DATE:** The USCG documented vessel data base was analyzed to develop characteristics of shallow-draft coastal vessels. An initial test design vessel New England lobster boat was selected. An available 1:50-scale model of the initial test design vessel and "typical



## Wilson, Design

harbor" was used to determine vessel maneuvering characteristics in waves. A 1:20-scale model of the initial test design vessel was constructed and testing was begun with varying environmental and operating conditions. Prototype maneuvering data have been obtained for this initial design vessel which will be compared to model results. Procurement of equipment to measure the 3-dimensional motion of the model vessel was accomplished and is being used. Prototype data of two typical design vessels have been obtained, including maneuvering in a restricted waterway with bends.

**FUTURE PLANS:** A second and third design vessel will be selected and the initial tests will be repeated. Therefore the effect of vessel size, lines, and appenditures and maneuverability on the port design can be determined. The results of the research will be used to update the Small Boat Navigation Channel Design Engineering Manual. Work will be coordinated with Phase I of the project to conduct a Shallow-Draft Coastal Port Design training course. A technical report reporting on the results of the program will be published.

**PRODUCTS:** Updated Small Boat Navigation Channel Design EM, Shallow-Draft Coastal Port Design training course, Technical Report reporting results of program.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 91

**EXPECTED COMPLETION:** FY 97

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** A Model Study of Olmsted Wicket Gates

**PRINCIPAL RED AREA:** Construction and Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Louisville District has prepared plans and specifications for a prototype wicket gate assembly to be installed in the Smithland Dam in the Ohio River. The prototype test results will be studied for evaluating the structural and hydraulic performance of the gates due to controlled operating conditions. A complete simulation of the actual flow pattern for permanent gates is beyond the scope of the prototype tests. A scaled model in support of the prototype design evaluation will be used to understand the flow-induced vibrational behavior of the gates.

A similitude model capable of simulating the actual flow pattern will be required to validate the prototype test results. Based on the satisfactory performance of the prototype gate, a final design recommendation will be made for permanent gates to be built in the Ohio Dam.

**OBJECTIVE:** The objectives of this study are: 1) to develop a similitude model for the wicket gates using hydraulic and structural scale laws, 2) to calibrate an analytical finite-element (FE) model by test/analysis correlations, and 3) to predict and investigate the response pattern for the prototype gate using the FE model for different operating conditions.

**OVERVIEW/APPROACH:** A geometrically similar scaled model for the prototype gate is developed to simulate the hydraulic and structural behavior of the system. The hydraulic similarity is achieved by equating the Froude and Strouhl numbers for both gates. This condition models the inertial, gravitational, and vortex shedding frequency of the river flow. The rigid body motions of the gate is modelled by considering the similarity of dynamic equation of motions for both gates.

Test data will be recorded for measuring the free-vibrational characteristics of the gate in dry and operating conditions (wet). The vibrational data collected during the operating condition will be used to measure the fluid-structure interaction of the system. The forced response and the input pressure will be measured for different flow conditions. The operating deflected shapes will be

Chowdhury, Olmsted

analyzed to understand the contributions of physical modes on the operating dynamics of the gate. This will identify any potential resonant problem due to flow-induced vibration of the gate.

A FE model will be updated using the test results for the scaled gate. The calibrated FE model will predict the response of the gate due to various possible combinations of flow conditions and boundary conditions. This analysis will be used to evaluate the design performance of the gate.

**IMPACT/PAYOFF:** This research greatly enhances the Corps of Engineers' capability to simulate, develop products, and verify structural design that meets design standards.

**PROGRESS TO DATE:** The flow-induced test data for a 1:25 scale gate model are recorded. These data are used to extract the modal information of the system and to predict the system response of a 1:5 scale gate model. A 1:5 scale gate model is constructed for further test and analyses. A preliminary FE model for the gate is developed to identify response point locations on the gate.

**FUTURE PLANS:** A dynamic response measurements testing program is planned for the 1:5 scale gate model. A correlation of the FE model with the test results will be made to update the analytical model. An analysis of the predicted response pattern will be used to evaluate the proposed design.

**PRODUCTS:** A report and a number of publications will result from this investigation. A recommendation will be made about the design performance of the gate.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 93

**EXPECTED COMPLETION:** FY 96

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** A Model Study of Montgomery Point Torque-Tube Gates

**PRINCIPAL R&D AREA:** Construction and Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** There is a need to better assess the dynamic structural response of prototype navigable-pass torque-tube gates in service at the Montgomery Point Lock and Dam project (part of the McClellan-Kerr Arkansas River Navigation System) for conformance with response standards, because current engineering design procedures are based on simplifying assumptions that idealize both the structural system and the exciting flow.

**OBJECTIVE:** (a) To construct a series of 1/15-scale physical models of the prototype gate embedded in an engineered flume to simulate the actual structural response upon hydrodynamics excitation for different operating conditions, and (b) to develop an experimentally-based finite element model of the system for the theoretical prediction of the prototype response based on calibrated structural parameters and pressure fields.

**OVERVIEW/APPROACH:** A series of physical model gates (brass) geometrically similar to the prototype gate (stainless steel) are to be constructed and embedded in an engineered flume at WES. Structural similarity is achieved by taking advantage of the static conditions of supports, which are instrumented with load cells to provide continuous spatial reaction information during dynamic response.

Structural parameters will be extracted from the experimental data under both dry and wet conditions. Eigen properties will be identified from preliminary tests and compared with the results of finite element analyses. The entire experimental exercise will serve to calibrate the finite element formulation of the model.

The representation of the input hydrodynamics pressure field on the gate under different operating conditions will be based on both experimental data and theoretical fluid dynamics formulations.

**IMPACT/PAYOFF:** This research project verifies the safety and serviceability of torque-tube gates at Montgomery Point under flow-induced vibrations.

de Bejar, Gates

**PROGRESS TO DATE:** The series of physical model gates have been constructed and embedded in an engineered flume at the Hydraulics Laboratory at WES, and the grid for the finite element analytical model has been completed.

**FUTURE PLANS:** The entire project will be completed during FY 94.

**PRODUCTS:** (a) A report on the results of the project, including recommended design changes to the original prototype, and (b) a technical journal paper.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** New Concepts for Repair and Rehabilitation of Hydraulic Structures

**PRINCIPAL R&D AREA:** Construction, Rehabilitation, and Operations

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The typical approach to repair and rehabilitation of hydraulic structures has been to use materials and methods generally associated with new construction. For example, navigation lock wall rehabilitation is usually accomplished by closing and dewatering the lock chamber; removing 1 to 3 ft of deteriorated concrete from the face of the walls; and replacing it with cast-in-place concrete. One of the most persistent problems with this approach is extensive cracking in the replacement concrete on all projects. Also, closing a lock to traffic during rehabilitation typically causes losses to the shipping industry ranging from \$300,000 to \$1,000,000 per day during the 30- to 60-day outage.

**OBJECTIVE:** The objective of the work in this R&D area is to develop innovative repair and rehabilitation systems that can be installed rapidly with minimal impact on project operations.

**OVERVIEW/APPROACH:** Compared with cast-in-place concrete, precasting offers a number of potential advantages including rapid installation, low unit cost through mass production, high quality, minimal cracking, durability, and mobility. Also, precasting minimizes the impact of adverse weather and makes it possible to inspect the finished product prior to its incorporation into the structure. Applications for precast concrete in repair and rehabilitation of hydraulic structures are being developed and evaluated. These applications include precast concrete panels as permanent stay-in-place forms for resurfacing navigation locks and dams and underwater repair of erosion-damaged structures; precast modules for partial and complete construction of dams, piers, abutments, and baffle blocks; precast linings and overlays for floodwalls and levees; precast concrete channel sections; and, precast panels to raise the crest and provide wave walls for embankment dams.

**IMPACT/PAYOFF:** This work will result in a variety of innovative materials and procedures for expedient and economical repair and maintenance of hydraulic structures with minimal impact on project operations and the environment.

McDonald, Hydraulic

**PROGRESS TO DATE:** A precast concrete stay-in-place forming system for resurfacing of lock chamber walls was designed and the constructibility of the system was demonstrated on two simulated lock wall monoliths. As a result of this work, the precast concrete system was selected for resurfacing of the lock chamber at Lock 22, Mississippi River, in 1989.

In addition to having superior durability and minimal cracking, the precast concrete system was installed in about one-half the time of conventional cast-in-place concrete. This application also demonstrated the system's potential for installation in an operational lock eliminating the necessity for lock closure and dewatering required in conventional repairs. As a result, a mobile coffer-dam system was developed which will allow panel installation in an operational lock chamber.

Based on the experience gained at Lock 22, the design of the precast concrete rehabilitation system was significantly enhanced prior to the second application at Troy Lock, Hudson River, during the winter of 1991-92. As a result of these improvements, the bid price for resurfacing the lock chamber with precast concrete was only \$33 per sq ft at Troy Lock compared to \$91 per sq ft at Lock 22. This cost for precast concrete was approximately \$5 per sq ft lower than the cost of cast-in-place concrete previously used at Troy.

Also, precast concrete panels were used to overlay the back side of the river wall at Troy Lock. The panels were installed in 1992 while the lock was in operation. The bottom row of panels was installed and the infill concrete placed underwater. An antiwashout admixture allowed the infill concrete to be effectively placed underwater without a tremie seal having to be maintained. The application of precast concrete resulted in an estimated savings of approximately \$500,000.

As a result of these successful applications, the New York State Thruway Authority (NYSTA) used the stay-in-place forming system to rehabilitate Lock 0-6, Oswego Canal, during the winter of 1992-93. Also, the NYSTA is currently using the same system for rehabilitation of Lock E-3 on the Erie Canal.

**FUTURE PLANS:** Applications of precast concrete in rehabilitation of navigation locks have demonstrated the significant advantages of precast concrete. Additional applications for precast concrete in repair and rehabilitation of hydraulic structures are currently being developed.

**PRODUCTS:** Five technical reports and two video reports to date.

**OTHER AGENCIES INVOLVED:** Various Corps of Engineer Divisions and Districts; New York State Thruway Authority

**START DATE:** FY 86

**EXPECTED COMPLETION:** FY 96

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Monitoring Navigational Conditions with Time-Lapse Photography

**PRINCIPAL R&D AREA:** Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** There are many areas along our inland waterways where navigation problems exist. Many of these problems are created by changes in channel alignment, channel depth, and current velocities and patterns after completion of the project. These problems can usually be corrected either with remedial structures or modifications to the channel.

However, identifying the factors creating the problem and determining the best remedial solution can require a study. Where a new structure (e.g. locks, dam, bridges) is being constructed, a new model study is usually the best tool for evaluation of navigation conditions and designing modifications to provide satisfactory navigation conditions. But where no major modifications are planned, evaluation of field data may provide a solution to the problem. Although technology has advanced to allow more cost effective collection of field data, techniques for collection and evaluation of the field data to determine causes and solutions for the problem have not been fully developed.

**OBJECTIVE:** Develop methods for collection and evaluation of field data (e.g. current velocities, current patterns and vessel movements) to identify navigation problems and provide remedial solutions. These methods must be easy and fast so data can be collected for a range of conditions (e.g. various riverflows and stage heights) at an economical cost. These methods would provide an economical tool to assist the design engineer in developing plans for solving navigation problems on our waterways.

**APPROACH:** Time-lapse video is being used at several projects to document navigation conditions, and software is being developed to evaluate the speed, orientation of the vessel, and its position as it enters and exits lock approaches. This method provides a means of collecting data over an extended period of time with minimal effort and cost. The equipment can be placed at the project and left unattended for extended periods of time. The video tapes are changed every two weeks for analysis.



## Wooley, Photography

**IMPACT:** This method will provide a cost effective means of recording and evaluating navigation conditions in critical reaches of our inland waterways system.

**PROGRESS TO DATE:** Time-lapse video is being collected at various projects and software is being developed for analyzing the data.

**FUTURE PLANS:** Continue collection of field data and development of analysis techniques.

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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Thermal Stress Analysis of McAlpine Gate Valve Monolith

**PRINCIPAL R&D AREA:** Operations and Inspection

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Cracking in mass concrete structures during construction is due to the restraint of strains induced by external and internal temperature changes and by shrinkage. This cracking can result in increased maintenance costs and increased vulnerability of the structures to earthquakes and other design loadings. Thermal stress analyses can be an effective and economical method for evaluating the effects of concrete mixtures, placement methods and schedules on cracking during construction. Thermal stress analyses of the McAlpine Lock structures were undertaken in compliance with ETL to insure that cracking during the construction of these monoliths was minimized.

**OBJECTIVES:** a) To numerically model the construction of the gate valve monolith using 3-D elements and a material model that includes creep, autogenous shrinkage, cracking, and the variation on concrete properties with age, b) to determine if lift height could be increased to 10 ft rather than the maximum of 5 ft which is frequently specified for mass concrete structures, and c) to determine the effect of placement schedule on cracking.

**OVERVIEW/APPROACH:** A 3-D analysis of the structure will be performed using the finite element code ABAQUS and a visco-elastic aging concrete model. The model has been calibrated to the results of tests performed on the design concrete at various ages. Initial conditions will include a start-of-placement date of June 21, 10 ft lifts, and lift placements at five day intervals. If significant cracking is predicted, placement conditions will be reevaluated and additional analyses will be performed.

**IMPACT/PAYOFF:** These analyses should allow evaluation of lift heights and placement schedules which can result in both minimum cracking and economical construction.

**PROGRESS TO DATE:** The initial heat transfer analysis of the 3-D finite element model is currently being performed on the WES Cray X-MP.

Garner, Valve

**FUTURE PLANS:** The final report will include recommended lift heights and placement schedules to minimize cracking.

**PRODUCTS:** Technical report

**OTHER AGENCIES INVOLVED:** None

**START DATE:** None

## TECHNICAL SESSION SUMMARY 1C: VESSELS /EQUIPMENT & HUMAN INTERACTION

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**TECHNICAL SESSION SUMMARY:  
VESSELS, EQUIPMENT & HUMAN FACTORS**  
by John Dumbleton (MARAD) and Don Beaumariage (NOAA)

Fourteen papers at two sessions on Vessels, Equipment & Human Factors included research related to pilots-human factors, training, and simulators; the use of GPS for surveys, dredging, and positioning buoys; studies of the effect of squat on vessel under keel clearances.

For the pilot related studies the benefits of research from the Small Business Innovative Research (SBIR) program involves partnerships with small entrepreneurial companies and other research and development ocean related companies. The presentation of the MARAD sponsored programs illustrated the potential of future interaction with the personnel of the other participating Federal Agencies, particularly the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard, and the National Oceanic and Atmospheric Administration's National Ocean Service.

The advantages of the **overall systems approach**, in which the human (pilot) is a major component along with the hardware, software, and procedures, were illustrated by the MARAD projects discussed. From the interactions of the working groups, additional technical sessions are planned; for example, between the participants in the new cooperative project in which the National Ocean Service will augment the Coast Guard VTS system at Bergen Point, Staten Island, New York City with current and water level measurement systems as extension of its PORTS-Physical Oceanographic Real Time System, in cooperation with the U.S. Army Corps of Engineers' activities there.

Considerable interest was exhibited by all participants in the **new uses of the GPS and differential GPS** being put into operation by the USCG. The uses include positioning buoys by USACE and applications to hydrographic surveys.

**VTS/PORTS**--Presentations on VTS and PORTS were given in other sessions. However, MARAD is very interested in working with the Coast Guard and NOAA in their project in New York to provide a PORTS capability at the existing VTS. MARAD's interests lie in bringing the commercial ship operators' viewpoints on ship operations into the design of the system. A meeting between MARAD and NOAA is planned to exchange ideas on this effort.

**HAZARD AVOIDANCE SYSTEM**--The Coast Guard, MARAD, and NOAA, as well as several commercial organizations met recently to discuss the development of an advanced shipboard navigation system using artificial intelligence technology, as well as other information technologies and real time environmental data (from PORTS). The system would incorporate electronic charts, differential GPS, and a data link to VTS. This effort may lead to a joint government/industry partnership to further develop the system.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: HUMAN FACTORS**

**PROJECT TITLE:** Department of Transportation Human Factors Coordination

**PRINCIPAL R&D AREA:** Human Factors and Safety of Operations

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION: PROBLEM STATEMENT:** Human factors are a critical element for safety and efficiency in all modes of transportation. Sharing of research efforts of mutual interest can be cost beneficial.

**OBJECTIVE:** Representatives from the different modes of transportation in the Department of Transportation are sharing human factors research needs and exploring common issues where collaboration can take place for the benefit of all.

**OVERVIEW/APPROACH:** A workshop on operator performance is being planned to look at research needs as an initial step to a shared research program on human factors.

**IMPACT/PAYOFF:** Cost savings and improvements in safety through improved human factors solutions to operational problems. Limited funding and shared efforts will accomplish more than individual modal approaches alone.

**PROGRESS TO DATE:** The group has met a number of times to plan for future activities.

**FUTURE PLANS:** Identify and develop research efforts of mutual interest cooperatively, sharing in the funding and execution.

**PRODUCTS:** Research into human factors in transportation.

**OTHER AGENCIES INVOLVED:** All Department of Transportation agencies.

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**Topic Statement**

**TOPIC AREA: HUMAN FACTORS**

**PROJECT TITLE:** Human Factors Research Program with Federal and State Academies

**PRINCIPAL R&D AREA:** Manning, Human Factors, Education, Competition

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Human error is the principal or contributing cause in some 80 percent of all accidents. Shipboard manning expenses are a critical component in the inability of U.S. ship operators to compete in foreign trade. Research and development must be accomplished to analyze and develop safe and environmentally beneficial manning practices, while providing the U.S. flag vessels with the ability to compete in foreign trade.

**OBJECTIVE:** Develop a "cooperative" research program with the Federal and State maritime academies for the purpose of addressing human factors research topics in the operation of ships including recruitment, education, training (including retraining, use of simulation), licensing, skills and task analysis, organizational relationships, workhours and overtime policies, traditional ergonomics and design issues, automation, system reliability and safety, hiring practices, physical requirements, and other related issues.

**OVERVIEW/APPROACH:** Identify potential research efforts and develop research programs to accomplish desired results. The process would include all members of the cooperative and involve coordination with ongoing research efforts by other parties.

**IMPACT/PAYOFF:** Safer, more efficient and competitive ships.

**PROGRESS TO DATE:** The concept of the cooperative is under development. Funds have not been programmed.

**FUTURE PLANS:** Develop options for the cooperative's operation, identify potential mutual interest efforts for the cooperative.

**PRODUCTS:** Research studies, shared cooperative research efforts, changed approaches to ship design, operations, manning, education, training, and competitiveness.

**OTHER AGENCIES INVOLVED:** State Maritime Academies, U.S. Merchant Marine Academy and other agencies performing related research.

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**Topic Statement**

**TOPIC AREA:** NAVIGATION AND HUMAN FACTORS

**PROJECT TITLE:** Vessel Piloting Cooperative Program

**PRINCIPAL R&D AREA:** Ship Piloting and Vessel Navigation Systems

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Improvements are needed in the safety of vessel navigation in harbors and restricted waters.

**OBJECTIVE:** Develop a "cooperative" research program with the State and National Pilot associations to identify and perform research and development of technology and issues relating to piloting and harbor or waterway systems including training.

**OVERVIEW/APPROACH:** Identify potential research efforts and develop research programs to accomplish desired results. The process would include all members of the cooperative and involve coordinating with other ongoing research efforts by other parties.

**IMPACT/PAYOFF:** Safer, more efficient and competitive ships.

**PROGRESS TO DATE:** A study on "Marine Navigation and Piloting" by the Marine Board of the National Academy of Sciences is nearing completion. This study will present the state of the art, identify problem areas, and make recommendations for improvement. Results from the study can provide the initial view to areas requiring research. The concept of the cooperative is under development. Funds have not been programmed.

**FUTURE PLANS:** Develop options for operation of the cooperative and identify potential efforts of mutual interest for the cooperative.

**PRODUCTS:** Research studies, shared cooperative research efforts, changed approaches to ship design, operations, manning, education, training, and competitiveness.

**OTHER AGENCIES INVOLVED:** State and national pilot associations.



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**Topic Statement**

**TOPIC AREA:** VESSELS, EQUIPMENT & HUMAN INTERACTION

**PROJECT TITLE:** Modular Models for Ship Simulation

**PRINCIPAL R&D AREA:** Simulation, Mathematical Modeling, Hydrodynamics, Modular Modeling, Ship Handling

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Ship maneuvering trajectory modeling has advanced and is currently extensively used for training of mariners in ship handling simulators. It is very difficult, however, to transfer a model of one ship from one simulator or modeling system to another. Additionally, changes in ship characteristics usually require model testing or considerable analytical effort to adjust the mathematical model. A means of separating interaction effects is needed to permit adjusting and exchanging data to permit accurate modeling of the models.

**OBJECTIVE:** Develop a modular approach for ship maneuvering simulation.

**OVERVIEW/APPROACH:** Several approaches to the organization and development of the components of modular models have been suggested. Study of the various approaches and methods of advancing the science is taking place through the Society of Naval Architects and Marine Engineers.

**IMPACT/PAYOFF:** Ability to model various hulls, rudders, and propellers accurately without model testing each combined variation separately.

**PROGRESS TO DATE:** A number of related projects are underway under MARAD and other Government sponsorship. Model test programs have been completed by the U.S. Coast Guard along with collection of full scale trials data. Development of proper models remains to be accomplished. A cooperative effort with the U.S. Corps of Engineers through the Society of Naval Architects and Marine Engineers is nearing completion.

**FUTURE PLANS:** Mathematical modeling approaches need further validation. Further model tests will be required to cover the range of ship types. International agreement on approaches to improving modeling is needed.

Landsburg, Modular

**PRODUCTS:** A number of reports and papers exist contributing to the effort. Some are listed here:

Modular Ship Maneuvering Models by Onassis and Hove, TNO-Iweco, Delft, Netherlands, May 1988.

"Prediction of Maneuverability of a Ship" by The Research Committee of Dynamic Performance, Maneuvering and Control Section, Bulletin of the Society of Naval Architects of Japan, No. 668, February 1985.

"Ship Maneuverability Analysis Using the Differential Approach" by Asinovsky, Landsburg, and Hagen, RINA Conference on Ship Maneuverability, London, England, April 29-May 1, 1990.

"A Review of Modular Maneuvering Models" by Robert Sedat, U.S. Coast Guard R&D Center, May, 1991.

**OTHER AGENCIES INVOLVED:** Coordination is taking place with the U.S. Army Corps of Engineers Waterways Experiment Station and the U.S. Coast Guard.

**START DATE:** FY 1990

**EXPECTED COMPLETION:**

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**Topic Statement**

**TOPIC AREA:** VESSELS, EQUIPMENT & HUMAN INTERACTION  
**PROJECT TITLE:** Shipboard Training and Control Simulator  
**PRINCIPAL R&D AREA:** Ship Maneuvering, Controllability, Simulation,  
Navigation, Decision Aid, Automation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Better decision aids are needed for vessel navigation for harbor and restricted water situations. Integrated bridge systems having electronic charting have ship trajectory prediction capability based only on speed and time. Shipboard personnel have little knowledge of how their ship maneuvers in restricted waters.

**OBJECTIVE:** Develop a ship maneuvering trajectory prediction software package for shipboard use in maneuvering assessment, passage planning, and training.

**OVERVIEW/APPROACH:** A limited prototype simulator will be based on state-of-the-art hydrodynamics models.

**IMPACT/PAYOFF:** Safer operations

**PROGRESS TO DATE:** Development of the prototype is complete.

**FUTURE PLANS:** Potential uses of commercial versions of the prototype need evaluation.

**PRODUCTS:** Draft report and demonstration computer package completed.

**START DATE:** FY 1991

**EXPECTED COMPLETION:**

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**Topic Statement**

**TOPIC AREA:** VESSELS/EQUIPMENT

**PROJECT TITLE:** Ship Maneuvering Study

**PRINCIPAL R&D AREA:** Maneuvering, Simulation, Hydrodynamics

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** There is a need to be able to predict the maneuvering characteristics of a ship during preliminary design or plan review, without conducting expensive model tests on each hull form.

**OBJECTIVE:** To develop a rational "modular" model of ship maneuvering, in which the forces on the hull, propeller and rudder (including interaction effects) can be calculated for any arbitrary vessel. These forces can then be used to predict ship performance during any specified maneuver.

**IMPACT/PAYOFF:** Development of a PC-based ship maneuvering simulator which can be used for preliminary design, pilot training, harbor design, and checking conformance of a proposed vessel with the new IMO maneuvering criteria.

**PROGRESS TO DATE:** Small and large scale tests on a MARINER class hull, including various combinations of appendages. Development and model testing of a systematic series of bare hull forms. Full scale trials of MARINER hull form. Evaluation of commercially available PC-based maneuvering software.

**FUTURE PLANS:** Development of a proposed mathematical model for modular modeling of ship maneuvering software.

**PRODUCTS:** (reports, publications, inventions)

1. Kopp, Bishop and Matter, "Experimental Study of the Rudder Flow Field and Its Effect on Hull Forces," DTRC SHD-1341-01, 1990.

2. Klosinski and Lewandowski, Systematic Series Model Tests, SIT-DL-93-9-2689, 1993.

Sedat, Study

3. Kopp and Rossignol, "Summary of a Full-Scale Maneuvering Trial on the USNS Observation Island (T-AGM 23), CRDKNSWC-HD-1432-01, 1993.

4. Zilman, "Desktop Ship Maneuvering Simulator, Documentation and User's Guide," Unpublished.

5. Sedat, Fuller, Lewandowski and Kopp, "A Proposed Modular Model of Ship Maneuvering-Project Summary," Coast Guard report, currently under development.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** 1989

**EXPECTED COMPLETION:** 1994

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION  
CONFERENCE "WATERWAYS MANAGEMENT-A PARTNERSHIP IN  
GOVERNMENT"  
Topic Statement**

**TOPIC AREA:** VESSELS/EQUIPMENT

**PROJECT TITLE:** DGPS User Equipment

**PRINCIPAL R&D AREA:** Dredging, Operations, Ice, Control, Navigation, Maneuvering,  
Automation, Decision Support.

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION:**

**PROBLEM STATEMENT:** Vessels are becoming increasingly reliant on precise radio navigation capabilities. Radio navigation has always been a supplemental source of navigation information. With the advent of DGPS, mariners are beginning to use radio navigation as their primary source for vessel guidance. Potential cost savings can also be realized by proper application of new GPS technologies.

**OBJECTIVE:** Investigate DGPS user equipment technologies and techniques that provide a level of integrity and reliability appropriate for navigating large vessels through confined waterways. Develop prototype proof-of-concept systems for testing and evaluation. Investigate the capabilities of GPS azimuth determination sensors.

**IMPACT/PAYOFF:** Recommendations to CGHQ regarding new technologies will influence policy and operational decision making. Development of system and techniques will make the Coast Guard more efficient through productivity improvements and cost reductions.

**PROGRESS TO DATE:** Shipboard integrity monitoring system has been developed and operational evaluations have been conducted on board a coastal buoy tender (RED WOOD 157' WPM). Results have been reported to CGHQ. GPS Attitude Determination System (ADS) has been developed. Initial tests have been conducted on board a CG 41' UTB, harbor tug and the TV Kings Pointer.

**FUTURE PLANS:** Improvements and enhancements to the shipboard integrity monitor are in process. More extensive testing of the GPS ADS on board icebreakers and as a sensor for VTS are planned.

## Spalding, Dredging Equipment

**PRODUCTS:** NAVSAFE™ Receiver Autonomous Integrity Monitor software for DOS systems provides shipboard measures of DGPS accuracy and reliability in real-time. Adroit GPS-ADS receiver system provides full GPS/DGPS navigation functionality and ships heading, pitch and roll in real-time.

**OTHER AGENCIES INVOLVED:** ACE-TEC has funded much of the work at Adroit to develop military application of GPS attitude determination. Without this research, CG resources would not have been sufficient to develop the shipboard system.

**START DATE:** FY 89

**EXPECTED COMPLETION:** FY 95

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**Topic Statement**

**TOPIC AREA: VESSELS/EQUIPMENT**

**PROJECT TITLE:** Navigation Effects Model Studies

**PRINCIPAL R&D AREA:** Rehabilitation, Navigation, and Other: Environmental Impacts and Tow-Induced Forces

**PRINCIPAL INVESTIGATORS:**

**NAMES:** Dr. Stephen T. Maynard and Ms. Sandra K. Martin

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Navigation effects studies have included both site specific studies and general research to quantify the flow field produced by a moving tow. Study concerns have been from both an engineering perspective related to design of stable channels and from an environmental view regarding effects of navigation forces on the surrounding biological community. The thrust of the engineering studies is to provide design guidance for riprap protection in confined channels such as those found in lock approaches. Environmental studies regard quantification of the physical effects for identification of detrimental effects to the habitat.

**OBJECTIVE:** To develop methods for quantifying the physical forces produced by moving tows in waterways with varied geomorphic conditions.

**OVERVIEW/APPROACH:** The objectives are being met with a combination of physical model testing and numerical studies. As a part of the environmental planning studies for the Upper Mississippi-Illinois Navigation Rehabilitation Study, a large physical model facility has been constructed at the YES. An extensive testing program, funded by the Rock Island, St. Paul, and St. Louis District Corps of Engineers, has been developed to address navigation effects in complex natural sections with ambient currents.

Also, research funding continues regarding the development of riprap design guidance for channels subjected to tow-induced waves and propeller jets. Additionally, a numerical approach using a depth averaged code will be used to supplement physical model testing and to evaluate site specific conditions that cannot be obtained in the physical mode.

**IMPACT/PAYOFF:** Design guidance for riprap design in confined channels will help to optimize the protection needed in these areas. Due to a lack of guidance in this area, previous site specific studies have resulted in over-designated riprap protection in areas where tow-induced forces dominate. Updated guidance will result in economic benefits regarding optimal riprap sizing.



## Maynard, Rehabilitation

**PROGRESS TO DATE:** Studies completed to date have included site specific evaluation of stone slope protection for the Tennessee-Tombigbee Waterway; Point Marion, Gallipolis, and Winfield locks on the Ohio River System. Other studies for the Louisville District have looked at tow-induced velocity distributions in wide channels, at tows sailing off the channel centerline, and flow conditions behind islands.

The navigation hydraulic research work unit has completed testing regarding riprap stability in uniform channels for a wide set of conditions for the purposes of providing guidance regarding riprap design due to tows underway in confined channels. The construction of the testing facility has been completed for the Upper Mississippi-Illinois River Navigation Effects Study.

**FUTURE PLANS:** Upon completion of these studies, it is likely that future work efforts will evolve around the application of the tools obtained from these studies. For instance, site specific analysis of a potential impact reach for mitigation purposes.

**PRODUCTS:** Numerous publications including WES Technical Reports have resulted as a product of studies to date. Expected products from ongoing projects will include: videos that help visualize navigation effects; updated guidance for Corps of Engineers Engineering Manual(s); miscellaneous conference, symposium and journal papers, WES technical reports on riprap design due to tow-induced waves, quantification of return currents, propeller-induced forces, navigation-induced sediments, analytical tools, and the Upper Miss project.

**OTHER AGENCIES INVOLVED:** St. Louis, St. Paul, Rock Island and Louisville Districts, National Biological Survey, various state agencies, and several private firms.

<b>PROJECT NAME:</b>	<b>START DATE:</b>	<b>EXPECTED COMPLETION:</b>
Louisville District Navigation Effects Studies	FY 89	N/A
Navigation Hydraulics Research Hydraulics Research	FY 90	FY 97
Upper Mississippi-Illinois River Navigation Effects Study	FY 93	FY 96

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**Topic Statement**

**TOPIC AREA: VESSELS/EQUIPMENT**

**PROJECT TITLE:** Vessel Underkeel Allowance

**PRINCIPAL R&D AREA:** Dredging, Navigation, and Maneuvering

**PRINCIPAL INVESTIGATOR:**

**NAME:** J. Christopher Hewlett

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Existing methods for calculating ship squat and trim in constricted waterways are poor. Very little physical data for such conditions are available. Current allowances for underkeel clearance in shallow, constricted waterways are very approximate. Improved prediction methods could result in specific reductions in dredging costs.

**OBJECTIVE:** The ultimate objective of this research is to pursue methods to avoid navigation channel over-dredging.

**OVERVIEW/APPROACH:** Determine feasibility of numerical models for calculation of underkeel clearance and compare to physical model data. Ultimate approach is to derive easily applied method for channel design.

**IMPACT/PAYOFF:** (see objective)

**PROGRESS TO DATE:** None. This is a new work effort.

**FUTURE PLANS:** A method of measuring squat and trim in physical models must be determined. A camera-based motion measuring system is available at WES at present which holds promise for being able to accomplish this task. Numerical modeling of similar hull shapes as those used in the physical model would be required as the basis for a comparison.

**PRODUCTS:** Numerical method or data base to be released to parties responsible for channel design.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 94

**EXPECTED COMPLETION:** FY 2000

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: VESSELS/EQUIPMENT**

**PROJECT TITLE:** Maritime System of the Americas

**PRINCIPAL R&D AREA:** Construction, Operations, Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** There is a need for vessels and vessel systems designed specifically for North American trade to more efficiently serve this fast growing segment of U.S. foreign trade.

**OBJECTIVE:** To develop a U.S. shipbuilding initiative for advanced state of the art construction of vessels designed for North American trade. These include RO/RO vessels, simple barge carrying vessel systems, integrated tug barges, and/or short-sea vessels.

**AGENCY OBJECTIVE:** To assure that the maritime mode participates in and contributes to the increasing trade within the Western Hemisphere.

**IMPACT/PAYOFF:**

The United States would have 1) one or more small, supra state-of-the-art shipyards producing small ships; 2) a fleet of ships developed to serve the North American trade and the national defense posture; 3) an opportunity to participate in the world shipbuilding market; and 4) more jobs for shipyard workers and for U.S. merchant mariners.

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**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: VESSELS/EQUIPMENT**

**PROJECT TITLE:** Development of a World Wide Oil Spill Model

**PRINCIPAL R&D AREA:** Navigation and Other: Environmental

**PRINCIPAL INVESTIGATOR:**

**NAME:** Dr. Billy E. Johnson

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** As a member of a consortium, the U.S. Army Engineer Waterways Station (WES) is involved in the development of an oil spill model that contains world wide data bases and runs on a personal computer.

**OBJECTIVE:** To develop an oil spill model that can be used in a rapid response mode as well as for contingency planning activities.

**OVERVIEW/APPROACH:** As a member of the consortium, Applied Sciences Associates (ASA) has been responsible for development of the model. The model (WOSM) is designed using a shell structure, to be a stand-alone, self-contained system. It contains all the databases, data manipulation and display tools, and models to simulate any type of oil spill. Models within WOSM provide rapid prediction spill trajectories, more detailed spill trajectory and oil weathering, and statistical prediction of trajectories in forward (stochastic) and reverse (receptor) modes. The model also allows for the import of detailed external data bases for modeling spills at particular sites.

**IMPACT/PAYOFF:** With the development of WOSM, the Corps of Engineers is able to predict the fate of oil spills under different scenarios. This information is required in contingency planning activities related to both environmental and navigation issues.

**PROGRESS TO DATE:** Basic model has been developed.

**FUTURE PLANS:** Additional developments to make the model more applicable in riverine environments are ongoing.

**PRODUCTS:** Computer model, data bases, users' guide, and technical manual.

**OTHER AGENCIES INVOLVED:** The consortium is composed of WES, ASA, several oil companies, and Environment Canada. WES is also currently involved in helping the U.S. Navy obtain the technology.

**START DATE:** FY 91

**EXPECTED COMPLETION:** FY 95

## TECHNICAL SESSION SUMMARY 2A: INFORMATION SYSTEMS FOR NAVIGATION

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**TECHNICAL SESSION SUMMARY:  
INFORMATION SYSTEMS FOR NAVIGATION  
by Margie Hegy (USCG) and Howard Danley (NOAA)**

Fifteen topic statements were scheduled to be presented during the technical session. The presentations were organized into three panels according to related topics. There were five presentations within each panel. A twenty minute question and answer or discussion period immediately followed each panel.

**Presentations in the first panel covered data infrastructure, bulletin boards, notice to mariners, and nautical chart updating.** Bulletin boards were the unifying theme for these presentations and lively discussion followed about how to organize them, how many there should be, who is coordinating them, and access to them.

It was pointed out that bulletin boards are relatively easy to establish and that there is a need to consolidate and standardize data formats and structures. There was agreement that customers and their requirements need to be identified. With the proliferation of bulletin boards, the time is approaching that a bulletin board of bulletin boards may need to be established.

**Recommendation:** The group would like to see a workshop convened to discuss bulletin boards and the concerns they raise.

**Presentations in the second panel covered PORTS, channel guidance systems, under keel clearance, water level measurement and vessel traffic services.** Discussion centered on the technical aspects of these subjects.

**Result:** Based upon the presentations the Maritime Administration plans to investigate a joint project with the National Ocean service involving PORTS; the Navy and Coast Guard a workshop on Real-time Data Services.

**Presentations in the third panel covered ECDIS, navigation aids for the automated bridge, real time charts, and raster nautical charts.** The discussion following this panel began to pull the topics of all three panels together. Many of the prior presentations produce products that will be integrated into ECDIS.

**Recommendations:**

- A working group on real time charts should be convened.
- There should be closer coordination between USACE and NOAA on chart distribution.
- There should be greater coordination of nautical charting and tide and current information.

## Summary: Information For Navigation

The general wrap up of all three panels included these additional action items:

- There is interest in acquiring data dictionaries.
- There is commonality between work being done by USACE and PORTS that needs to be explored.
- There is considerable interest in raster data and the consensus is that one format is needed.
- There is support for a working group to be formed.

The purpose of the conference was met and in some respects exceeded. From the discussion sessions it is apparent that there is considerable interest in the projects presented. Participants freely shared information, and opportunities for future jointly conducted projects or workshops were proposed.

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS-NAVIGATION**

**PROJECT TITLE:** Navigation Ideas for an Automated Bridge

**PRINCIPAL R&D AREA:** Navigation, Maneuvering, and Decision Support

**PRINCIPAL INVESTIGATORS:**

**NAMES:** Craig Elicker and Norbert Reis CODE 332  
NCCOSC RDT&E Division Detachment  
P.O. Box 5152  
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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** NCCOSC has developed a shipboard ocean survey system which collects, processes, and records time-correlated data to produce high accuracy charts of bathymetry, gravity, and other oceanographic parameters for use by the fleet.

With advances in computer technology and firmly established technologies for bathymetric navigation survey available, developmental efforts have shifted to increasing system automation to improve survey system accuracy, operability, and productivity. Computer based graphic displays, processing, and controls are now available to assist the operators in the task of conning the ship and conducting the overall survey operations.

Based on today's cost critical environment, the integrated survey system features mission sensor subsystems linked through a Local Area Network (LAN) to mission control and processing subsystem workstations to provide centralized survey control. The graphical displays developed include visual representations of planned survey lines, navigational and environmental parameters, and system operating modes, status, and alarms.

In addition to these displays, an automatic ship's track keeping system has been developed to provide track control based on position data as opposed to the conventional means of steering a prescribed heading. This paper presents these displays and controls and shows how they can be used in the automation of a ship's bridge. Future system enhancements for mission planning and ship's safety also will be discussed.

These systems have been developed utilizing industry standard computers, network interfacing, operating systems, programming languages, and techniques to maximize system portability and adaptability. Special emphasis has been placed on user friendly interfaces with displays in the x-windows graphics environment utilizing the OSF/Motif style.



## Elicker & Reis, Aids

Although these systems and displays have been developed specifically for ocean survey vessels, they can be implemented easily with little or no modifications for inclusion into any type of vessel for adding the overall safety, efficiency and effectiveness of navigating the nation's Waterway System.

**PROGRESS TO DATE:** The systems and displays discussed in this paper are currently implemented on the ocean survey vessels USNS Maury and USNS Wyman.

**FUTURE PLANS:** Develop working systems and displays for navigating, maneuvering and decision support for ocean or waterway vessels.

**OTHER AGENCIES:** None

**START DATE:** 1991

**EXPECTED COMPLETION:** Ongoing

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**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS-NAVIGATION

**PROJECT TITLE:** Channel Guidance Systems for Deep Draft Ships (EMOGS for Ohio Submarines and Carrier Channel Guidance System for Aircraft Carriers)

**PRINCIPAL R&D AREA:** Decision Support, Navigation

**PRINCIPAL INVESTIGATOR:**

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Naval Surface Warfare Center  
Bethesda, MD 20084-5000

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Deep draft aircraft carriers and submarines are required to transit shallow and exposed channels to home ports. Wave and tide conditions may produce conditions that would cause the ship to touch the channel bottom.

**OBJECTIVE:** The objective was to predict the clearance between the keel of the ship and the channel bottom before the transit to determine the risk of grounding.

**OVERVIEW/APPROACH:** The approach to determining the clearance between the ship keel and the channel bottom is to determine the effective channel depth and the effective draft of the ship.

The effective channel depth is the sum of the channel depth at mean lower low water, astronomic tide, and meteorologic effects on the water level. The effective ship draft is the sum of the static draft, linkage and trim, and the wave induced vertical motions at the bow and stern of the ship. the difference between the depth and draft yields the net effective clearance of the ship keel (or critical point on the ship) and the channel bottom.

This net effective clearance is associated with a risk level to help the user identify the high risk clearance levels. The system developed for the OHIO class submarine is land based and applicable to only one port. The system for the aircraft carriers is ship based and applicable to five different ports.

**IMPACT/PAYOFF:** Improves safety of deep draft ships transiting shallow entrance channels to home and secondary ports because it identifies the wave and tide conditions that could cause grounding. The systems also lessen the need for dredging the channels deeper.

Silver, EMOGS

**PROGRESS TO DATE:** The landbased system for the OHIO class submarine is complete and operational. The shipboard system for the aircraft carriers is being tested on board two carriers. Once testing is complete, the system will be installed on all active carriers.

**FUTURE PLANS:** It is possible that another land based system, similar to the one for the OHIO class submarine could be developed for the nuclear aircraft carriers using the North Island Naval Air Station at San Diego.

**PRODUCTS:** The basic product is software and documentation in the form of reports. The software for the OHIO class submarine runs on a Micro VAX; the software for the carriers runs on an IBM PC.

**OTHER AGENCIES INVOLVED:** The U.S. Army Corps of Engineers helped set up wave measuring stations at San Diego, Pearl Harbor and Norfolk. The Corps of Engineers Coastal Engineering Research Center's shallow water wave tank was used to perform a model test of carriers.

A separate climatology was required for San Diego because WIS did not have any accounting for waves generated in the southern hemisphere. Therefore, a climatology using measured data was required to be generated. The motion transfer functions of the nuclear aircraft carrier were validated, under a separate program, at the Waterways Experiment Station Coastal Engineering Research Center's shallow water tank.

**START DATE:** 29 September 1993 **EXPECTED COMPLETION:** 30 June 1994

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**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS

**PROJECT TITLE:** Environmental Information from NOAA Water Level Measurement Networks

**PRINCIPAL R&D AREA:** Near Shore Wave Information, Real-Time Environment Monitoring

**PRINCIPAL INVESTIGATOR:**

**NAME:** Dr. H. H. Shih

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Coastal wave conditions are important environmental information for ship operations, especially small commercial and recreational crafts. The collection of such data sets, however, is quite difficult and expensive. Using the NOAA Next Generation Water Level Measurement System (NGWLMS), we should be able to obtain surface wave information indirectly.

**OBJECTIVE:** This project is to prove the feasibility of and to develop the algorithms for deriving wave information routinely from the NOAA water level observation network. This will utilize an undeveloped capability of the installed NGWLMS network (presently at 127 stations along the U.S. coasts) at an insignificant additional cost to that already spent on the water level measurement. The systems are now ready to incorporate directly other environmental sensors such as wind, barometric pressure, air and water temperature, solar radiation, precipitation, dew point humidity, and current.

**OVERVIEW/APPROACH:** Statistically, wave heights can be related to the standard deviation of free surface elevation which is one of the standard output parameters from the NOAA water level measurement systems. Preliminary work by NOAA, University of Colorado and Corps of Engineers/CERC showed qualitatively that the NOAA system could provide a first order estimate of significant wave height. We plan to demonstrate quantitatively the feasibility by analyzing several data sets. Subjects to be investigated include the effects of tides, wind and wave characteristics, wave period estimates, accuracy of the estimates, product formats, interface with NOAA information systems, and implementation requirements.

Shih, Environmental

**IMPACT/PAYOFF:** The safety of ship operation in congested coastal waters, especially hazardous cargo carriers and small commercial and recreational crafts, is affected by local environmental conditions such as wind and waves. This study is intended to fully utilize the capability of NOAA's modern water level observation network and provide the needed information. This near real-time environmental information can help reduce ship accidents and increase marine commerce.

**PROGRESS TO DATE:** A study plan has been prepared. Data sets have been collected and pertinent literature was reviewed.

**FUTURE PLANS:** We are looking for partnerships and funding.

**PRODUCTS:** Real-time surface wave information.

**OTHER AGENCIES INVOLVED:** We are looking for partnerships from state or federal agencies (such as Corps of Engineers, Coast Guards, EPA).

**START DATE:** April, 1994      **EXPECTED COMPLETION:**

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**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Vessel Traffic Systems and Services

**PRINCIPAL R&D AREA:** Communications, Remote Sensing, Automation,  
Database Management, Operations, Control, Navigation, Decision Support,  
and Human Factors

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Increased commercial demands placed on the nation's ports threaten to increase the risk to vessels navigating these ports, limit the port's economic growth, and diminish the port's safety, environmental quality, and security.

There is strong Congressional interest in the utilization of emerging technologies, such as DGPS, ECDIS, and modern radar and communications technologies, in the new generation of VTS's. It is imperative that the Coast Guard consider these technologies to the extent practical and feasible. VTS-2000 will not only introduce "state-of-the-market" equipment, but will completely change the way VTS watchstanders operate and interface with the user community.

The human factors aspect of a new generation of VTS watchstanders will need extensive analysis as work loads shift and efficiency become paramount. The end result is the effectiveness of VTSs to reduce casualties of all types and safely facilitate commerce. This will need to be measurable. Presently, the above-mentioned areas are not well-thought out or documented. The public will expect more concise assessments of our considerations for emerging technologies, watchstander efficiency, and after the fact, precise measurements of VTS effectiveness.

**OBJECTIVE:** Develop, evaluate, encourage, and demonstrate advanced vessel traffic management technologies, methods, and services that support increased marine traffic in the nation's ports while maintaining or improving the economic benefits, safety, environmental quality, and security realized by those using these ports.

**IMPACT/PAYOFF:** The goal of this project is to create those economically acceptable sensor, validation, and communication technologies, standards, and methods that will improve the safety, security, and efficiency of the nation's critical marine terminal areas while protecting the environment, conserving energy, and expanding terminal capacity.

**PROGRESS TO DATE:** Developed navigation, communication, and display technology needed to demonstrate potential VTS automatic dependent surveillance technologies.

**FUTURE PLANS:**

1. Conduct tests of automatic dependent surveillance in Narragansett Bay, R.I. area using four communications methods, and issue report.
2. Develop computer model to assist design of "high capacity" automatic dependent surveillance service using VHF digital selective calling technology.
3. Develop, design, construct, and demonstrate a digital real-time marine safety information dissemination service.
4. Develop supplemental requirements for IMO ECDIS performance standard when used in VTS control areas.
5. Sponsor VTS sensor technology development.

**PRODUCTS:** Narragansett Bay Automatic Dependent Surveillance demonstration system

**OTHER AGENCIES INVOLVED:** Volpe National Transportation Systems Center

**START DATE:** 1993

**EXPECTED COMPLETION:** 1999

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**Topic Statement**

**TOPIC AREA:** Information Systems

**PROJECT TITLE:** Raster Nautical Charts

**PRINCIPAL R&D AREA:** Data Services, Navigation, Automation, Decision Support, Database Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Improve navigation tools

**OBJECTIVE:** Produce a complete suite of NOAA nautical charts in digital raster format.

**IMPACT/PAYOFF:** Data support for electronic charting systems which will provide improved navigation.

**PROGRESS TO DATE:** Project is funded. 1,500 prototype raster nautical charts have been distributed for public comment. Full scale production is approaching.

**FUTURE PLANS:** Complete production of the entire NOAA nautical chart suite as digital raster files within 2 years.

**PRODUCTS:** Digital files for public sale.

**PROJECT START DATE:** November 1992

**EXPECTED COMPLETION:** December 1995



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**Topic Statement**

**TOPIC AREA:** Information Systems

**PROJECT TITLE:** Real-Time Nautical Charts

**PRINCIPAL R&D AREA:** Data Services, Navigation, Automation, Decision Support, Database Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Improve navigation tools.

**OBJECTIVE:** Produce a digital chart that updates itself in real time with tides and water current data.

**IMPACT/PAYOFF:** Improved support for electronic charting systems which will provide improved navigation.

**PROGRESS TO DATE:** Project was funded April 1994.

**FUTURE PLANS:** Bergen Point, New York, will be instrumented with telemetering tide and current gages. Existing navigation soft-ware will be modified to allow for changing plotted depths in real time and overplotting of current vectors.

**PRODUCTS:** Report.

**PROJECT START DATE:** April 1994

**EXPECTED COMPLETION:** December 1995

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT – A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS

**PROJECT TITLE:** National Safe and Efficient Waterways Computer Bulletin Board System

**PRINCIPAL R&D AREA:** Data Services, Navigation, Automation, Decision Support, Database Management

**PRINCIPAL INVESTIGATOR:**

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Silver Spring, MD 20910

**PHONE:** (301)713-2724 **FAX:** (301)713-4516

**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Improve distribution of navigation data.

**OBJECTIVE:** Produce a computer bulletin board (BUS) jointly supported by NOAA, Corps of Engineers, Coast Guard and Defense Mapping Agency that will give a single-point-of-access to navigation data.

**IMPACT/PAYOFF:** Improved support for electronic charting systems which will provide improved navigation.

**PROGRESS TO DATE:** Two interagency meetings have been held to discuss the concept. NOAA is operating a BBS for experience. SCG, DMA and COE are likewise operating BBS'.

**FUTURE PLANS:** Uncertain

**PRODUCTS:** Report

**PROJECT START DATE:** April 1992

**EXPECTED COMPLETION:** Uncertain

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**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS

**PROJECT TITLE:** Nautical Chart Update Service

**PRINCIPAL R&D AREA:** Data Services, Navigation, Automation, Decision Support, Database Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Nautical charts start becoming obsolete immediately after they are printed. Changes are published as text descriptions of chart corrections in the Local Notice to Mariners. The corrections are difficult to apply and are frequently not. A better method of providing timely chart corrections that will be applied is needed.

**OBJECTIVE:** Develop a new method of producing and distributing nautical chart corrections.

**IMPACT/PAYOFF:** More nautical chart corrections correctly applied.

**PROGRESS TO DATE:** Limited tests of graphic correction "patches" production and distribution.

**FUTURE PLANS:** Continue tests at low level.

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**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** PORTS (Physical Oceanographic Real-time System)

**PRINCIPAL R&D AREA:** Dredging, Operations, Data Services,  
Navigation, Decision Support, Risk Analysis.

**PRINCIPAL INVESTIGATOR:**

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Silver Spring, MD 20910

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**PROJECT DESCRIPTION**

**OBJECTIVE/BENEFITS:** Development of a marine information and dissemination system to provide oceanographic and meteorological information critical for: safe and cost-effective navigation (esp. of large ships), search and rescue, hazardous material spill prevention and response, and environmental assessment.

PORTS includes the integration of real-time currents, water level, density, and wind at multiple locations with a data dissemination system that includes telephone voice response, modem dial-up and Internet access. Research involves use of the latest observational technology, numerical modeling, and nowcasting/forecasting techniques.

**PROGRESS TO DATE:** A complete PORTS is now operating in Tampa Bay, FL, successfully providing the above mentioned information to the local marine community. NOS has turned over day-to-day operation to a local not-for-profit corporation. NOS has initiated two new demonstration projects to implement PORTS at one site each in ports of New York, New Jersey and San Francisco Bay.

**PLANS FOR THE FUTURE:** NOS is implementing PORTS sensors at Bergen Point NJ, with data acquisition and dissemination at the USCG VTS Center on Governor's Island, NY. The information will be provided to the VTS center in support of special area requirements. NOS is developing a numerical model of the circulation of New York and New Jersey harbor in support of Oil Pollution Act '90 exercises. NOS will improve oil spill model spatial validity and demonstrate integration of PORTS into a real-time ECDIS displays. NOS is implementing a system of real-time salinity sensors between Carquinez Strait and the Delta of the San Joaquin and Sacramento Rivers in the upper San Francisco Bay. The system will provide information for management of fresh water being rediverted from municipal uses and agricultural irrigation to restore the fisheries nursery and increase the margin of safety of the transport of oil.

Wilmot, PORTS

**KEYWORDS/DESCRIPTORS:** Navigational information systems; real-time oceanography; marine forecasting.

**REPORTS/PUBLICATIONS/INVENTIONS:** Contact author.

**COORDINATION WITH OTHER AGENCIES:** Coast Guard, National Weather Service, state agencies, port authorities, pilots' associations and academic marine research institut

**PROJECT START DATE:** 1990

**EXPECTED COMPLETION DATE:** Ongoing

**FUNDING:** FY 94 \$459,000

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**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS-NAVIGATION**

**PROJECT TITLE:** Portable Water Level Gauges

**PRINCIPAL R&D AREA:** Water Level Instrument, Real-Time Environment Monitoring

**PRINCIPAL INVESTIGATORS:**

**NAMES:** Thomas N. Mero/H. H. Shih

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Silver Spring, MD 20910-3281

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** A need exists for a reliable, digital portable water level measurement system that can transmit real-time data to users in remote areas. This would greatly improve the efficiency of operations such as waterway dredging, water resources management, hydrographic and photogrammetric surveys, and ship navigation.

**OBJECTIVE:** This project is to finalize the development of portable water level measurement system designs for a variety of potential users and measurement requirements.

**OVERVIEW/APPROACH:** Portable water level measurement systems using either pressure or acoustic sensors have been developed. The pressure-based system using UHF line-of-sight (LOS) radio for data communication has been successfully used in the past year by NOAA hydrographic survey parties in Alaskan coastal waters. Recently, acoustic-based systems using both LOS radio and GOES data communications were also tested successfully. We plan to work together with other interested parties (e.g., NOS photogrammetry, COE, and Florida and Texas state environmental agencies) to finalize the system designs.

**IMPACT/PAYOFF:** The capability of providing real-time, digital water level information to users at any sites shall be extremely useful to decision making personnel.

**PROGRESS TO DATE:** Design guides for portable gauges have been established. A limited number of prototype units have been used by NOAA for hydrographic survey and the states of Florida and Texas for coastal river measurement. Four systems are being fabricated for the NOS Photogrammetry. Partnership with COE in coast/inland waterway applications is being explored.

**FUTURE PLANS:** We are looking for partnerships and funding.

Mero/Shih, Water

**PRODUCTS:** Modular portable digital water level gauge designs and support software and documentation which can meet the measurement needs of NOS' Hydrographic and Photogrammetric Survey applications as well as numerous other users such as COE, state environmental agencies.

**OTHER AGENCIES INVOLVED:** State or federal agencies (such as Corps of Engineers, Coast Guards, EPA).

**START DATE:** April, 1994      **EXPECTED COMPLETION:** September, 1996

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**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS - NAVIGATION

**PROJECT TITLE:** ECDIS: Current Status/Future Expectations

**PRINCIPAL R&D AREA:** Vessel Navigation Systems Standards Development, Integrated Navigation Systems Test and Evaluation

**PRINCIPAL INVESTIGATOR:**

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1082 Shennecossett Road  
Groton, CT 06340

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Currently employed vessel navigation systems do not take advantage of new technologies associated with radio/radar navigation, sensor fusion, automated decision aids, and electronic charts. Prior to adopting new standards and regulations for Electronic Chart Systems (ECS) including ECDIS, a more thorough understanding of the operational capabilities and limitations is required.

**OBJECTIVE:** Conduct RDT&E on the capability and effectiveness of currently available and prototype ECDIS and ECS, and proposed standards in cooperation with other government agencies, foreign nations, research institutions, and the private sector. For ECDIS, recommend appropriate carriage requirements, type approval/ certification, mariner training/certification, and associated updating services.

**OVERVIEW/APPROACH:** Working in close cooperation with C&GS/NOAA, USCG has conducted a comprehensive T&E program to assess the operational capabilities and limitations of ECDIS. These trials have primarily focused on testing the adequacy of ECDIS performance standards being developed by the International Hydrographic Organization (IHO) and the International Maritime Organization (IMO). The T&E included a comparison of ECDIS versus more "traditional navigation" in confined waterways, a human factors evaluation of ECDIS using a bridge simulator facility, and extensive at-sea trials of ECDIS onboard a USCG ocean-going Buoy Tender and a merchant marine academy training vessel. The over-riding goal of the U.S. ECDIS T&E Program has been to evaluate ECDIS from the Mariner's perspective.

**IMPACT/PAYOFF:** The eventual employment of ECDIS will have a profound impact on all aspects of maritime navigation, piloting, and safety. The advent of DGPS, ECDIS and other forms of integrated navigation systems will also have a major effect on the type, number and



Alexander, ECDIS

location of fixed and floating aids to navigation (ATON) services provided by the USCG. However, ECDIS should be considered as another component of the overall waterways navigation management system.

**PROGRESS TO DATE:** In close cooperation with Coast and Geodetic Survey/NOAA, the U.S. Coast Guard has been conducting a comprehensive test and evaluation program to assess the operational capabilities and limitations of current and prototype ECDIS and Electronic Chart Systems (ECS) and proposed performance standards. Two important aspects of this program include the Coast Guard's participation in the U.S. ECDIS Testbed Project and the establishment of a U.S.-Canada Cooperative Research Program on ECDIS. An update on the status of the ECDIS and ECS research, development, test and evaluation in North America and Europe will be presented.

**FUTURE PLANS:** The U.S. Coast Guard is the lead United States maritime authority responsible for regulating the operation of commercial vessels engaged in U.S. trade. There are significant policy and regulatory implications associated with ECDIS related to system specification, shipboard installation, performance standards, training, certification, and the means to update electronic charts.

**OTHER AGENCIES INVOLVED:**

C&GS/NOAA,

USACE

MARAD

DMA

USN-SPAWAR Canadian CG

Canadian Hydrographic Service

German Ministry of Transport (Summer 1994)

Japan Maritime Safety Agency (1995)

Norwegian Hydrographic Service/Norwegian Coast Directorate (1995)

**START DATE:** FY 90

**EXPECTED COMPLETION:** FY 99

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT - A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS-NAVIGATION

**PROJECT TITLE:** ECDIS for River Navigation

**PRINCIPAL R&D AREA:** Navigation, Operations, Decision Support,  
Human Factors, Data Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Keeping up-to-date navigation charts in printed form is costly and time consuming; as a result new hydrographic data and body locations are not usually current. Accurately locating a ship or a tow in a waterway and identifying its rate of motion is often difficult. Use of short-range aids to navigation (buoys, ranges, etc.) are often used in waterways; however, buoys are often relocated as the water level changes and/or are lost or off-station due to various causes.

**OBJECTIVES:** To provide real-time accurate positioning and movement information for navigation in restricted waterways based on up-to-date electronic navigation charts and Differential Global Positioning System DGPS). To determine the benefits to navigation, particularly on the river and to define the necessary and beneficial features of an ECDIS system.

**OVERVIEW/APPROACH:** With the USCG/NOAA ECDIS Testbed Project software and Corps of Engineers' hydrographic surveying and mapping data, electronic navigation charts of the Mississippi River covering the area from St. Louis to Southwest Pass will be created and a differential GPS system installed on a Corps' working towboat, MV MISSISSIPPI.

The testbed ECDIS program will be modified to include several features necessary for restricted waterway navigation. Demonstrations of the working system will be conducted. A test reach will be selected and a navigation testing program will be conducted to demonstrate the value of ECDIS to river navigation.

**IMPACT/PAYOFF:** Increased navigation safety by providing the navigator accurate position information relative to navigation hazards and the navigation channel. Reduced aids to navigation maintenance costs. Reduced navigation channel dimensions, construction and maintenance costs and dredging. Improved operational efficiency.

Park, ECDIS

**PROGRESS TO DATE:** Electronic charts have been created for over 1000 miles of the lower and middle Mississippi River from St. Louis to New Orleans. The NOAA/USCG/COE testbed ECDIS system has been modified to include features needed for navigation in restricted waterways and inland tow traffic; including,

- a) fathometer data display
- b) dual screen display
- c) depth color contour legend
- d) vessel configuration icon creation and
- e) bridge information display.

Differential global positioning system reference stations established from St. Louis to New Orleans along the Mississippi River.

System implementation aboard the COE MV MISSISSIPPI and demonstration during 1993 and 1994 High Water Inspection trips.

**FUTURE PLANS:** To establish an interface with the REGGIS data base system for generation of electronic navigation charts. Establish procedures to updating engineering structures within the waterway, developing bridge pier data, and updating of aids to navigation positions and situations. To complete generation of electronic charts and update with recent hydrographic data. Perform tests of application to navigation on the inland waterways.

**PRODUCTS:** Electronic navigation charts for 1000 miles for the Mississippi River from above St. Louis to below New Orleans in DX-90 format. ECDIS system operational aboard MV MISSISSIPPI.

**OTHER AGENCIES INVOLVED:** USCG and NOAA

**START DATE:** FY 93

**EXPECTED COMPLETION:** FY 95

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** INFORMATION SYSTEMS-NAVIGATION  
**PROJECT TITLE:** Waterways and Navigation Data Services (WANDS)  
**PRINCIPAL R&D AREA:** Information Systems

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**OBJECTIVE/BENEFITS:** Investigate the policies and procedures that regulate the production and dissemination of the Local Notice to Mariners. Look for solutions that reduce costs and increase effectiveness of gathering, processing, and disseminating navigation information among government agencies and to mariners.

**PROGRESS TO DATE:** A series of reengineering workshops was conducted to 1) model the current process including data requirements and estimated costs, 2) develop alternative strategies for disseminating marine safety information, and 3) select a recommended strategy from among the alternatives and do detailed design and cost estimation on the strategy.

A three-phase change plan was recommended. 1) Look at cost reduction strategies for printing and mailing. Put the text of the current 10 Local Notices on the GPS Information Center computer bulletin board. 2) Standardize format and method of preparation of all 10 Local Notices. Automate preparation and use a common data base for data collection, Local Notice generation, and dissemination to USCG and other agency users. Make the approved/validated safety information in that data base available on the computer bulletin board. Migrate as many users as possible to computer access. 3) Provide touch-tone telephone access to computer data base to allow custom printing and mailing of navigation safety information products. Eliminate printing and mailing of Local Notices.

**PLANS FOR FUTURE:** Phase I is being actively pursued. Phase II will be pursued over the next few years as funding allows. Phase III is seen as a future growth path to be revisited down the road. At the same time, use of the navigation safety data base for electronic chart updates will be investigated.

**KEY WORDS/DESCRIPTORS:** Navigation information, notice to mariners

Ruete, WANDS

**REPORTS/PUBLICATIONS/INVENTIONS:** Final Report for the Process Redesign of the Local Notice to Mariners, 24 September 1993

**COORDINATION WITH OTHER AGENCIES:** Workshops involved active participation of personnel from NOS and the Naval Academy Sailing Squadron.

**PROJECT START DATE:** FY 93      **EXPECTED COMPLETION DATE:** FY 94 (R&D involvement)

**FUNDING:** FY 93 \$185 K

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**TOPIC STATEMENT**

**TOPIC AREA: INFORMATION SYSTEMS-NAVIGATION**

**TITLE:** Implementation of the National Spatial Data Infrastructure

**PRINCIPAL R&D AREA:** Data Services, Automation, Decision Support, Database  
Management, Communications, Geographic Information Systems

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Information technologies are changing the way governments and other organizations conduct business. A growing reliance on the use of computers for processing information is increasing the demand for electronic data. In no arena is this more true than in the use of technology to analyze and manage information related to geography--so call "Geo-Spatial" data. These data are critical to solving today's complex environmental, economic, and social problems. Geographic Information Systems (GIS) technologies, offering new approaches to the analysis of spatial problems, require vast amounts of geospatial data in digital form. The use of GIS for waterway management offers special challenges to the developers of Geographic Information Systems, including hardware, software, data base design and management, and human engineering.

**OBJECTIVE:** The overall objective is to improve access to and facilitate the sharing of geospatial data. Initial activities include the development of standards for data formatting and exchange, meta data (data documentation standards), electronic data clearinghouse via the Internet communications system, and the identification of critical or framework datasets of national importance. This will be accomplished through the creation of a National Spatial Data Infrastructure (NSDI).

**IMPACT/PAYOFF:** Benefits will be improved, efficient and effective port and harbor management, applications of new techniques, modelling and simulation of environmental impacts, alternatives to dredging, and economic impacts.

**PROGRESS TO DATE:** A Strategic Plan for the NSDI has been developed. The Data Clearinghouse has been prototyped and is currently being implemented. Standards have been developed for data exchange and documentation.

Lockwood, SDI

**FUTURE PLANS:** Building the SDI data base will be accomplished by the year 2000.

**PRODUCT:** Fully functioning NSDI

**START DATE:** January 1994      **Expected Completion:** January 2000

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**Topic Statement**

**TOPIC AREA: INFORMATION SYSTEMS**

**PROJECT TITLE:** Airborne Electromagnetic Survey System to Locate Articulated Concrete Mats in Mississippi River

**PRINCIPAL R&D AREA:** Construction, Rehabilitation, Decision Support, and Inspection

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** To control the levee erosion and limit re-mobilization of river sediment, articulated concrete mats (ACM) have been placed on the river bottom over large segments of the Mississippi River. These ACM are easily monitored by acoustic methods when they are on the surface of the river bed. However, as silt or sand cover, the mat and the three inch thick concrete segments become buried. Acoustic systems are no longer able to monitor their condition or location. Other techniques such as self potential, resistivity and electromagnetic techniques were evaluated under a project managed through the U.S. Army Corps of Engineer's Geotechnical Laboratory, Vicksburg, MS. All these techniques were used to detect the stainless steel wire that are used to connect the concrete mat segments together. The electromagnetic component of this work was implemented at the Naval Research Laboratory, Stennis Space Center, MS.

**OBJECTIVE:** Adapt new sideband, airborne electromagnetic (AEM) technology that was developed for the Navy to measure shallow water hydrography in turbid coastal marine environments to the riverine task of detecting and monitoring ACM rapidly from helicopter platforms.

**OVERVIEW/APPROACH:** The approach has been implemented in three phases. The first phase was designed to test the concept with a suite of preliminary electromagnetic measurements that were acquired using the NRL continuous wave system when deployed over ACM on a non-conducting float. These measurements were successful. Each 50 meter wide segment of the electrically continuous mat was detected and estimates of the conductance from the electromagnetic data were similar to expected values. The second phase of the work was planned to evaluate the use of transient electromagnetic methods to improve estimates of mat depths and condition. Data that were acquired during this phase of the effort are currently under evaluation. The final phase of the work was designed to test the performance of the Navy's AEM continuous wave system with an expanded bandwidth over a range of ACM conditions. During this phase of the work, the AEM system will be deployed 20-30 meters above the water in a towbody that



## Mozley, Electromagnetic Survey

are composed of both in-phase and out of phase signals with respect to the transmitted wave form at multiple frequencies simultaneously. These data are recorded and then used to calculate the towbody height, water depth, and depth of the mat within the sediment. Positioning and AEM timing are provided by a GPS antenna located on the towbody.

**IMPACT/PAYOFF :** The AEM technique can provide a rapid airborne reconnaissance tool for river management. The mapping of buried ACM to verify condition and coverage can potentially save a vast amount of construction work associated with the redeployment of buried ACM sections.

### **PROGRESS TO DATE:**

Surface measurements in the Mississippi River have been made successfully and estimates of the conductance of the mat were on the same order as expected values. A wide band 30 - 30,000 Hertz AEM system has been fabricated and ground tested.

**FUTURE PLANS:** A flight test of wide band AEM system is scheduled for completion in June 1994. The refinement of interpretation techniques and deployment methods, which use AEM technology to remotely monitor the condition and position of ACM segments, are scheduled for completion in late FY 94 and early FY 95.

**PRODUCTS:** New Survey technology to assess the condition of ACM positioned along the Mississippi River.

**OTHER AGENCIES INVOLVED:** Sponsor: U.S. Army Corps of Engineers Geotechnical Laboratory, Vicksburg, MS

**START DATE:** FY 92

**EXPECTED COMPLETION:** FY 95

## TECHNICAL SESSION SUMMARY 2B: FACILITIES FOR DREDGING

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**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES-DREDGING**

**PROJECT TITLE:** Channel Depth Requirements Due to Wave Induced Vertical Motion

**PRINCIPAL R&D AREA:** Dredging, Operations, Navigation, and Risk Analysis

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Entrance channels typically require additional depth to allow for vertical motion of ships due to wave action. A navigation channel deepening project does not necessarily deepen the entrance channel and the harbor channel by the same amount. The entrance channel may require additional deepening due to increased length, beam, and tonnage of the vessels calling. This can have a significant effect on the project's benefit/cost ratio.

**OBJECTIVE:** Provide guidance as to the amount of additional entrance channel depth required for various sizes and classes of vessels in different wave conditions.

**OVERVIEW/APPROACH:** The present hydrodynamics model used by the WES Ship/Tow simulator is capable of calculation, the vertical motion caused by wave action. An extensive effort is required to ensure that the vertical motion algorithm is verified for present operating conditions at various ports. Once verified, the algorithm will be included in a new "fast-time" model which will allow the user to select a design ship from a library of vessels (type, length, beam, and draft). The user will be able to input channel depth and heading; wave height, direction, and period; wind magnitude and direction; and current magnitude and direction. The model, in which the vessel will travel a predetermined path, will record groundings and vertical clearances. This information will be used in the reconnaissance phase of the navigation project. The channel depth guidance will be verified during the real-time simulation program.

**IMPACT/PAYOFF:** The guidance provided during the reconnaissance phase of the navigation project will allow districts to estimate more accurately the project's cost and evaluate design alternatives such as stepped channels.

**PROGRESS TO DATE:** None, study is not funded.

**FUTURE PLANS:** Initiate study.

**PRODUCTS:** The vertical motion model and a report describing the required modeling techniques will be developed.

**START DATE:** Budget Year

**EXPECTED COMPLETION:** Budget Year+3

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**Topic Statement**

**TOPIC AREA: FACILITIES-DREDGING**

**PROJECT TITLE:** Risk-based Planning and Management of Maintenance Dredging

**PRINCIPAL R&D AREA:** Dredging, Operations, Navigation, Automation, Decision Support,  
Management Analysis, Risk Analysis, Training, Planning

**PRINCIPAL INVESTIGATORS:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Maintenance dredging comprises a significant component of the Corps' operations & maintenance budget. In addition, it represents a major component of future project costs for new navigation projects. The extent of dredging determines the reliability of the project dimensions and influences the economic performance of the project.

Typically, estimates of dredging requirements and costs are based on historical rates of sedimentation and experience. In many instances, particularly for new or changed projects, these estimates are highly uncertain. The Corps needs a comprehensive framework to combine the physical aspects of sedimentation and dredging with the economic costs and benefits of dredging, all of which are uncertain.

**OBJECTIVE:** The purpose of this research is to develop and apply a risk-based approach to maintenance dredging. This research will aid in the allocation of funds for competing dredging projects by focusing on the management tradeoffs in terms of project reliability and economic performance. The results will be applicable both to prioritize dredging for existing projects and to estimate the tradeoffs and dredging requirements for new or expanded projects.

**OVERVIEW/APPROACH:** Building on a completed conceptual framework, this research focuses on the development of a reliability-based dynamic dredging decision model (RED'). The RBD' is a simulation and optimization model that incorporates information about predicted navigation channel dimensions and dredging requirements to estimate channel reliability and dredging costs. The research also examines the economic effects of both: 1) different levels of channel reliability and 2) uncertainty in reliability. The focus is on the shipping industry response including private risk-management efforts.

**IMPACT/PAYOFF:** The RBD' provides a method of prioritizing dredging projects based on economic efficiency and opportunity costs. It includes a risk-based method to estimate

Moser, Skaggs, Risk

project dredging related to channel reliability and can be used to develop more accurate, if less precise, estimates of future dredging costs and project performance for planning purposes.

**PROGRESS TO DATE:** In FY 92, reviewed state of practice. Recommendations made on application of existing conceptual framework and on sedimentation model. Developed a dredging cost/reliability/productivity model as input to uncertainty model. Initial runs made of computer sedimentation model to determine feasibility of response surface methods. In FY93, developed industry response to uncertainty in channel depth including estimating economic costs. Incorporated revised dredging cost with uncertainty model, and conducted initial evaluation of combined model. Developed simulation, optimization, and control routines for prototype model. In FY 94, complete draft report on economic costs associated with channel reliability. Develop, test, and demonstrate RBDI prototype.

**FUTURE PLANS:** Conduct workshop on RBD' model use with field personnel. Revise model based on field input. Complete user's guide and software documentation.

**PRODUCTS:** Report on reliability-based dynamic dredging decision model, computer software, and user manual with documentation in FY 95.

**OTHER AGENCIES INVOLVED:** None thus far, although a workshop for potential users is planned after the software has been tested and enhanced.

**START DATE:** FY 92

**EXPECTED COMPLETION:** FY 95

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES - DREDGING**

**PROJECT TITLE:** A Risk-based Decision Support System (DSS) for Maintenance Dredging

**PRINCIPAL R&D AREA:** Dredging, Operations, Navigation, Automation, Decision Support, Management Analysis, Risk Analysis, Training, Planning

**PRINCIPAL INVESTIGATORS:**

**NAMES:** David A. Moser and L. Leigh Skaggs

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The management of maintenance dredging, particularly in a dynamic natural environment, involves increasingly complex and uncertain information on sedimentation, dredge productivity, vessel traffic, and dredging unit costs. In the past, a variety of strategies for dealing with these risks and uncertainties were employed to assure satisfactory project performance. Many of these require additional costs. This increased complexity along with budgetary pressures is requiring that dredging decisions be made with less margin for error and greater understanding of the cost-reliability trade-offs.

**OBJECTIVE:** To develop and improve the management of maintenance dredging activities by explicitly recognizing risk and uncertainty within the context of a decision support tool. This tool, the risk-based DSS incorporating a modeling approach, will provide Corps maintenance dredging managers a means to test alternative dredging management decisions.

**OVERVIEW/APPROACH:** This research builds on the conceptual design for a risk-based DSS developed for and with the Corps' New Orleans District. It is anticipated that the model will be applied in a case study framework, and procedures and recommendations for transferring the model to other locations will be provided.

**IMPACT/PAYOFF:** The model will allow dredging managers to test maintenance decisions beyond their historical experience. This will provide the opportunity to reduce costs and yet maintain project efficiency.

**PROGRESS TO DATE:** In FY 92, developed detailed requirements for the risk-based DSS. Documented and validated current decision process used for dredging decisions. Developed dredging cost/reliability/productivity model. In FY 93, developed detail of the model prototype. Revised decision model process based on District input. Estimated economic costs associated with channel reliability. In FY 94, identify and modify software for DSS requirements, incorporating

Moser/Skaggs, Dredging

dredging cost, economic cost, and estimated channel depth modules. Code, test, and demonstrate prototype DSS.

**FUTURE PLANS:** Conduct workshop on the DSS model with headquarters and field personnel. Revise model based on field input. Complete user's guide, maintenance guidelines, and software documentation.

**PRODUCTS:** Report on decision support system for maintenance dredging, computer software, and user manual with documentation in FY 95.

**OTHER AGENCIES INVOLVED:** None thus far, although a workshop for potential users is planned after the software has been tested and enhanced.

**START DATE:** FY 92

**EXPECTED COMPLETION:** FY 95

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**Topic Statement**

**TOPIC AREA: FACILITIES-DREDGING**

**PROJECT TITLE:** Long-Term Fate of Dredged Material Disposed in Open Water

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The Corps often experiences delays in obtaining state and Federal agency approval of proposed locations for placement of dredged material. Whether a site is dispersive or nondispersive is a primary issue in a site-designation investigation. One important aspect of site classification is the stability of the mound over long periods of time. If the site can be shown to be nondispersive (sediment not eroded and transported outside the limits of the designated site), those concerned with possible contamination of adjacent areas may be supportive of the proposed site.

**OBJECTIVE:** A generalized long-term site classification procedure to determine whether a site is dispersive or nondispersive is required by the Corps to support all site-designation studies.

**OVERVIEW/APPROACH:** This PC (and mainframe) model computes the long-term stability of a dredged material disposal mound in open water by calculating the time evolution of the mound as a function of waves, currents, depths, geometry, and material comprising the mound. A data base of wave and current information along all coasts of the U.S. has been developed to support these modeling efforts. Application of this model is critical for predicting the stability of capped contaminated sediment mounds and sites.

**IMPACT/PAYOFF:** Use of this model has previously allowed the continued utilization of open water disposal sites in New York (and other locations), resulting in saving at least \$8 million from not having to designate alternate site to the Mud Dump Site for disposal of contaminated materials.

**PROGRESS TO DATE:** The procedures for generating waves, tidal elevations, and currents, and the mechanics of completing the computations, creating the data base are developed and fully verified.



McNair, Long-Term

**FUTURE PLANS:** The PC models and procedures are available for immediate Corps field office application.

**PRODUCTS:** Procedures for predicting the long-term fate of dredged material disposed in open water.

Scheffner, N.W., 1991, "A Generalized Approach to Site Classification--Dispersive or Nondispersive," Dredging Research Information Exchange Bulletin, Vol. DRP-91-1, pp. 1-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Teeter, A.M., 1992, "Erosion of Cohesive Dredged Material in Open-Water Disposal Sites," Dredging Research Technical Notes DRP-1-07, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA:** FACILITIES-DREDGING

**PROJECT TITLE:** Short-Term Fate of Dredged Material Disposed in Open Water

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Regardless of the location or character of an open water dredged material disposal site, an integral part of the problem of assessing the environmental impact of placement operations is the ability to determine the spatial and temporal distribution of the dredged material following its discharge into the water. The description of the fate of material discharged requires a model of considerable generality and complexity. The disposal site environment may include time-dependent currents that vary significantly in three dimensions, density stratifications, and variable depths. The material itself may be a composite ranging from slow-settling extremely fine particles to fast-falling coarse particles, and may include a soluble fraction.

**OBJECTIVE:** A Single Operation Short-Term Fate (SSTFATE) numerical model, refined under the Dredging Research Program, calculates the suspended sediment concentrations from the disposal of dredged material from a barge or hopper dredge. The model computes the bottom footprint (area and thickness) of the disposed dredged material mound from a single disposal operation. SSTFATE also simulates multiple disposal operations to show the time-dependent creation and transport of a full sized mound. Results from this program are input to long-term fate models to address site capacity and dispersive questions.

**OVERVIEW/APPROACH:** The short-term behavior of the disposed material is assumed to be separated into three phases: convective descent, during which the dump cloud or discharge jet falls under the influence of gravity; dynamic collapse, occurring when the descending cloud impacts the bottom or reaches a neutrally buoyant position in the water column; and long-term passive diffusion, commencing when the material transport and spreading are determined more by ambient currents and turbulence than by dynamics of the placement operation.

McNair, SSTFATE

**IMPACT/PAYOFF:** Benefits result from using SSTFATE to determine the need for additional testing in permitted disposal operations. Benefits have resulted from the continued use of open water sites in the Puget Sound close to dredging projects.

**PROGRESS TO DATE:** SSTFATE is fully developed, and has been calibrated and verified in scaled-model physical laboratory disposal operations.

**FUTURE PLANS:** SSTFATE is an easy-to-use PC-based numerical disposal model available for immediate Corps field office use.

**PRODUCT:** SSTFATE is a PC program for predicting the initial fate of dredged material disposed in open water.

Johnson, B.H., McComas, D.N., McVan, D.C., and Trawle, M.J., 1993, "Development and Verification of Numerical Models for Predicting the Initial Fate of Dredged Material Disposed in Open Water; Report 1, Physical Model Tests of Dredged Material Disposed from a Split-Hull Barge and Multiple Bin Vessel," Technical Report DRP-93-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Johnson, B.H., 1990, "Numerical Disposal Modeling," Dredging Research Technical Notes DRP-1-02, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES-DREDGING**

**PROJECT TITLE:** Point Load Test (PLT) for Weak or Saturated Rock Materials

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Dredging contractors' claims are often based on material strength changes, especially when the dredging project contains rock conditions. It was desired to develop an instrument to quickly determine on-site the strength characteristics of weak or saturated rock materials.

**OBJECTIVE:** Procedures have been developed for the point load testing (PLT) of weak or saturated rock typically found in a coastal dredging environment. The PLT and companion data system were designed to store, retrieve, and compare rock test data.

**OVERVIEW/APPROACH:** The PLT allows for quick on-site monitoring of dredged material strength to obtain an index for rock material strength using easily portable equipment. The point load index strength can be correlated to unconfined compressive strength. The PLT also is useful in dredging exploration because tests can be performed on cores immediately while material is in as-taken conditions without the usual precaution for handling and storage.

**IMPACT/PAYOFF:** Benefits result from more complete information for reconnaissance or final exploration to produce more efficient planning and project design. Benefits also come from point load to unconfined compressive strength correlations allowing for determination of strength for a wider spectrum of site materials, thus resulting in better contract specifications. The PLT can be performed on a site specific basis and compared to the background of other sites. The PLT and a computerized database system also may produce cost avoidance by preventing contractor claims since such claims are often based on material strength changes.

McNair, PLT

**PROGRESS TO DATE:** A compact PLT instrument has been developed and fully verified in field and laboratory applications for testing rock samples at a navigation dredging project.

**FUTURE PLANS:** The PLT is presently available for determining rock strength index in Corps field dredging applications.

**PRODUCT:** The PLT is an instrument for testing strength of weak or saturated rock in a dredging project.

Smith, H.J., 1990, "Suggested Methods for Use of Point Load Tester in Dredging Applications," Dredging Research Technical Notes DRP-2-01, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Smith, H.J., 1991, "Point Load Index and Unconfined Compressive Strength Data Base System," Dredging Research Technical Notes DRP-2-02, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** FACILITIES-DREDGING

**PROJECT TITLE:** Drilling Parameter Recorder (DPR)

**PRINCIPAL R&D AREA:** Dredging, Operations, Database Management

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** In recent years, the Corps has experienced problems in planning, estimating, and executing rock dredging work, primarily due to differing site condition claims. These claims are commonly based on the contention that there is more rock or that the rock encountered is harder to dredge with available mechanical equipment than the contractor had inferred from bidding documents. In coastal deposits where rock is highly variable and interbedded, disputes as to the areas and vertical extent of rock correlate with claims based on difficulty of excavation.

**OBJECTIVE:** It was desired to develop an instrument to characterize areas and vertical extent of rock material before dredging actually began.

**OVERVIEW/APPROACH:** The Drilling Parameter Recorder (DPR) is an instrumentation and data acquisition system for a drill rig that provides a continuous record of the operational parameters which relate to rock material properties. Another benefit of this system is the correlation of the drilling parameters with unconfined compressive strength. Laboratory site calibration tests have been performed on uniform materials to verify and understand the capabilities of the DPR. The system has been tested with limestone/sandstone, and rock stimulant for strength correlation. The DPR can save laboratory testing and field production costs for a given number of site borings. In addition, where core recovery is poor, contact elevations will be more accurate since the DPR provides a continuous record of parameters related to material characteristics relative to depth.

**IMPACT/PAYOFF:** Benefits result from the exploration costs of drilled cored holes requiring casing versus less expensive roller bit holes. For roller bit holes, it is not necessary to put down casings or take cores for most of the holes. A cored hole would be drilled near a roller bit hole

McNair, DPR

where the DPR was used for correlation purposes. Then roller bit holes with the DPR would be drilled in the vicinity, and if DPR characteristics remain constant, it would be concluded the materials are similar. Or, for the same amount of funding, a region of interest could be more intensely covered with roller bit borings. This is especially important in regions of variable site conditions.

**PROGRESS TO DATE:** The DPR has been calibrated and verified during prototype field applications at Corps foundation investigation drilling sites.

**FUTURE PLANS:** The DPR is presently available for immediate application at Corps navigation dredging site investigations.

**PRODUCT:** The DPR is an instrumentation and data acquisition system for providing continuous record of operational parameters of a drill rig.

Smith, H.J., 1991, "Rock Dredging Exploration Using the Drilling Parameter Recorder," Dredging Research Information Exchange Bulletin Vol. DRP-91-2, pp. 1-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES - DREDGING**

**PROJECT TITLE:** Rapid Measurement of Consolidated Sediment Properties

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Each year the Corps spends hundreds of millions of dollars on river and harbor maintenance and ship channel realignment projects. Currently, the Corps relies on drilling and laboratory testing programs to assess marine sediments in terms of material type, density, and thickness for purposes of characterizing proposed dredging sites. However, sampling and coring programs are costly, provide only discontinuous information about material characteristics, and cannot effectively address situations where actual subbottom conditions are highly variable.

**OBJECTIVE:** An acoustic impedance processing technique has been developed to remotely and efficiently determine characteristics of subbottom marine sediments as they relate to dredging. A low-noise, high-resolution subbottom imaging system is essential to this program. To fulfill this requirement, a digital data acquisition system has been combined with specialized processing software to accurately assess bottom and subbottom in situ conditions.

**OVERVIEW/APPROACH:** The acoustic impedance method of subbottom profiling is a modification of the seismic reflection technique commonly used in offshore oil exploration, and is tailored to shallow-water environments. Wave velocities are controlled by elastic properties of the two-phase sediment mass (sea water in pores and mineral structure). Properties such as porosity and grain size affect sound velocity only through their effects on the elasticity of the sediment. The acoustic impedance of the surficial layer can be readily calculated. The relationship between acoustic impedance and specific soil properties has been empirically determined from an extensive database of world averages. The acoustic-based system accurately measures the thickness of different sediment layers in the subbottom. A seismic source of known energy content as a function of frequency deployed just below the water surface generates acoustic waves that propagate downward through the water column and sediments. High-



## McNair, Measurement

profiling systems specifically designed for shallow-water use and operating at frequencies below 12 Khz are used.

**IMPACT/PAYOFF:** Benefits result from continuous coverage of bottom and subbottom conditions for optimum boring placement. Environmental enhancements come from monitoring cultural resources and long-term monitoring of disposal berms. Mission enhancements result from predictions of slope stability, location of under-channel utilities, and determination of fluid mud zone thickness. Cost avoidance may be derived from contractor claims regarding volume of material associated with material changes, reduced borings, and changes in channel routing to avoid undesirable conditions.

**PROGRESS TO DATE:** A fully developed system for acoustic impedance processing of seismic reflection data has been proven in field tests with calibrated surveys.

**FUTURE PLANS:** System is presently available for immediate application at Corps navigation dredging projects.

**PRODUCT:** An acoustic impedance processing system for navigation channel subbottom profiling.

Ballard, R.F., Sjostrom, K.J., McGee, R.G., and Leist, R.L., 1993, "A Rapid Geophysical Technique for Subbottom Imaging," Dredging Research Technical Notes DRP-2-07, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES - DREDGING**

**PROJECT TITLE:** Capping Technologies for Open Water Dredged Material Disposal Sites

**PRINCIPAL R&D AREA:** Dredging, Construction, Operations

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Capping is the controlled, accurate placement of contaminated material at an open water disposal site, followed by a covering or cap of clean isolating material. The term "contaminated" refers to material found to be unacceptable for unrestricted open water placement because of potential contaminant effects, while the term "clean" refers to material found to be acceptable for such placement.

Level bottom capping is defined as the placement of a contaminated material on the bottom in a mounded configuration, and the subsequent covering of the mound with clean sediment. Contained aquatic disposal is similar to level bottom capping but with the additional provision of some form of lateral confinement (for example, placement in bottom depressions or behind subaqueous berms) to minimize spread of the materials on the bottom.

**OBJECTIVE:** Design guidance was required for site selection, equipment and placement techniques, capping, and monitoring of the site to ensure chemical contaminants were not migrating through the cap from biological reworking of the sediments.

**OVERVIEW/APPROACH:** A capping operation should be treated as an engineered project with carefully considered design, construction, and monitoring to ensure that the design is adequate. The basic criteria for a successful capping operation is simply that the cap thickness required to isolate the contaminated material from the environment be successfully placed and maintained. The contaminated sediment must be characterized from physical, chemical, and biological standpoints. Capping as an alternative is usually considered only after determining that benthic effects resulting from unrestricted open water placement would be unacceptable.

## McNair, Capping

**IMPACT/PAYOFF:** Monetary benefits easily result from placing contaminated sediments in open water and capping with clean materials, when compared with exceedingly more expensive methods of treating contaminated materials or disposing at upland sources.

**PROGRESS TO DATE:** Design requirements have been developed for capping material and equipment for accurate controlled placement of both contaminated sediments and the capping material at open water dredged material disposal sites.

**FUTURE PLANS:** Design guidance and technology are presently available for application by Corps field offices where the capping of contaminated sediments at an open water disposal site is a viable alternative.

**PRODUCT:** Technology for the controlled, accurate placement of contaminated material at an open water disposal site, followed by a covering of clean isolating material.

Palermo, M.R., 1991, "Design Requirements for Capping," Dredging Research Technical Notes DRP-5-03, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Palermo, M.R., 1991, "Site Selection Considerations for Capping," Dredging Research Technical Notes DRP-5-04, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Palermo, M.R., 1991, "Equipment and Placement Techniques for Capping," Dredging Research Technical Notes DRP-5-05, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Palermo, M.R., Fredette, T., and Randall, R., 1992, "Monitoring Considerations for Capping," Dredging Research Technical Notes DRP-5-07, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Navigation Channel Sediment Management

**PRINCIPAL R&D AREA:** Dredging, Construction, Rehabilitation, and Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** On navigable rivers the management and control of sediment through specific reaches are important factors in maintaining satisfactory and stable navigation channels with no or a minimum amount of maintenance dredging. This allows the USACE the ability to maintain the maximum number of projects with minimum funds.

**OBJECTIVE:** Reduce or minimize maintenance dredging by management of river sediments.

**OVERVIEW/APPROACH:** Site-specific model studies to develop river training structure plans including dikes and headway whirs have proven cost effective and extremely successful in the past to accomplish this objective.

**IMPACT/PAYOFF:** River training structures have reduced maintenance dredging requirements and provided an environmental benefit in that with less dredging there is less dredged material that needs to be deposited in or adjacent to our waterways.

**PROGRESS TO DATE:** Site-specific studies on St. Louis Harbor, the proposed Montgomery Point Lock and Dam, and Redeye Crossing on the Mississippi River are on-going studies where river training structure plans are being developed for maintenance of navigation channels. WES has conducted over 100 of such studies in the past.

**FUTURE PLANS:** It is anticipated that similar studies will be conducted on problem reaches in the future with possibly greater emphasis of the lower Mississippi River deep-draft channel. Studies have been initiated relative to lock replacement studies on the upper Mississippi River. Hydropower retrofit studies such as those proposed for Melvin Price Locks and Dam, Mississippi River will be conducted.

Pokrefke, Dredging

**PRODUCTS:** Results of the studies mentioned above will be presented in WES technical reports. Previously conducted studies are reported in specific technical reports for the project and are available through the WES Library.

**OTHER AGENCIES INVOLVED:** USACE has worked with USCG on improvement plans for St. Louis Harbor and with the recently constructed dikes at Redeye Crossing, Mississippi River.

**START DATE:** FY 91

**EXPECTED COMPLETION:** FY 95

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Improved Eductors

**PRINCIPAL R&D AREA:** Dredging, Construction, Operations

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Eductors (jet pumps) are hydraulic pumps with no moving parts, relying instead on an exchange of momentum to entrain the slurry. Eductors have been used for sand bypassing at inlets since the early 1970s with vary degrees of success. Improvements in increased debris resistance and ease of deployment and retrieval were identified by Corps field operating offices as items required to make eductor sand bypassing more widely applicable.

**OBJECTIVE:** The objective of this research effort was to develop design improvements to increase the resistance of the eductor to debris accumulation thus increasing pump production, and to increase of deployment and retrieval.

**OVERVIEW/APPROACH:** Eductor modifications were designed, constructed, and evaluated. Some of the design features include a smooth cylindrical outer shape to prevent debris (logs and sticks) from jamming in the eductor and making retrieval difficult, a series of fluidizing nozzles around the perimeter of the tip to fluidize the sand for removal and to allow heavy debris to sink below the eductors, a grate over the entrance to prevent debris from entering the suction chamber, and a ring jet to reduce pullout forces.

Tests were conducted at a sand company's operational source, as it closely simulated applicable conditions at coastal bypassing locations. The test location had a large area of clean sand (mean diameter 0.3 mm) in excess of 25 ft thick that could be saturated to simulate a coastal environment. Instrumentation included production meters and video cameras to document each test. Performance of the improved eductor was significantly better than the previous generation in the presence of stones and garbage bags; however, it may be more prone to clogging with driftwood.

McNair, Eductors

**IMPACT/PAYOFF:** Benefits of the eductor include the lack of a requirement for constant operator control, and the relative immunity to line plugging makes the eductor well suited to long-term bypassing operations. The choice of a particular eductor and modification will depend on the type and amount of debris present.

**PROGRESS TO DATE:** Full-scale prototype field tests were conducted to develop eductor improvements which reduce debris effects and increase pump production.

**FUTURE PLANS:** Improvements in eductor design are presently available for immediate application which increase debris resistance and increase ease of deployment and retrieval.

**PRODUCTS:** Eductor (jet pump) design improvements for increased debris resistance, and ease of deployment and retrieval.

Clausner, J.E., Welp, T.L., and Bishop, D., 1993, "Controlled Tests of Eductors and Submersible Pumps," Dredging Research Technical Notes DRP-3-05, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Mambo, G. and Clausner, J.E., 1989, "Jet Pump Sand Bypassing, Indian River Inlet, Delaware," Dredging Research Information Exchange Bulletin, Vol. DRP-8s-2, pp. 1-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES - DREDGING**

**PROJECT TITLE:** Development of Electrical Resistivity Methods for Measurement of Sediment Consolidation And De-Watering Potential of Dredged Material Disposal Areas

**PRINCIPAL R&D AREA:** Dredging

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Methods are needed for instrumentation that can reliably measure the rate of consolidation and the de-watering potential of dredged slurries in disposal areas. Currently available instrumentation for accomplishing this is based on nuclear density measurement principles. Because of safety and regulatory reasons, these methods are usually not considered. Electrical resistivity methods are commonly used for geophysical exploration. Previous studies have proven that these methods can reliably measure fluid mud and dredged slurry densities. The electrical resistivity probes used in these studies are inexpensive to build and are safe to operate.

**OBJECTIVE:** To develop an automated instrumentation system based on electrical resistivity methods for measuring the consolidation of dredged slurries in disposal areas.

**OVERVIEW/APPROACH:** Electrical resistivity probes were designed and constructed for measuring fluid mud and dredged slurry densities under the Dredging Research Program (DRP). The probes were automated using a personal computer based data acquisition system. These probes could be installed in dredged slurry disposal areas for monitoring material consolidation/de-watering.

**IMPACT/PAYOFF:** The data from these probes will provide site managers with guidance for de-watering the sites and provide realtime information on the volume of material in the site.

**PROGRESS TO DATE:** The resistivity probe was developed under the dredging research program. A prototype probe for use in dredge hoppers was constructed and automated. The dredged material disposal site application has not been funded.



Scott, Dredging

**FUTURE PLANS:** The final report describing the design and application of the resistivity probe will be published at the end of FY 94.

**PRODUCTS:** A prototype probe with associated automation.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 89      **EXPECTED COMPLETION:** FY 94

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**Topic Statement**

**TOPIC AREA:** FACILITIES - DREDGING

**PROJECT TITLE:** Fluid Mud Survey System

**PRINCIPAL R&D AREA:** Dredging, Operations, Decision Support

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Much of the sediment materials dredged from waterways is estuarine fine-grained, cohesive, mud with densities ranging from 1.05 to 1.35 g/cu cm. Thick layers of fluid mud occur at some times and at some places, especially in estuarine areas of the Gulf of Mexico and southeastern Atlantic coast regions of the U.S. Here, fine sediments are frequently resuspended and trapped by hydrodynamics conditions.

Fluid muds generally form an area of steep vertical density gradient near the bed, are slow to consolidate, and can persist in a fluid-like state for long periods. A particular fluid mud is navigable if its density and viscosity are sufficiently low. Hence, a navigation channel in a region of fluid mud must be sufficiently deep to avoid adverse effects on shipping. Of the parameters most directly related to navigability, only density can be measured in situ.

**OBJECTIVE:** Methods for intrusive survey and analysis of fluid mud channel bottoms have been developed around a navigable depth concept. The overall goal is to reduce channel maintenance costs by improving dredging efficiency through better definition of bottom conditions in areas of fluid mud. Rheologic analysis of mud samples has been used to establish conservative, physics-based criteria that can be used to gage when bottom elevations are safe for vessel passage.

**OVERVIEW/APPROACH:** A Fluid Mud Survey System has been developed which integrates an instrumented towed sled, a conventional dual-frequency acoustic depth sounder, and hydrographic survey positioning-control and logging components. The towed sled has nuclear-transmission density, pressure, cable tension, and multiple tilt sensors. The sled has been adjusted to ride at a certain shear resistance when towed, corresponding to a density slightly higher than that where the material begins to exhibit continuous interparticle cohesion. Navigable depth is obtained by direct contact with the physical horizon where resistance to motion increases sharply.

McNair, Mud

**IMPACT/PAYOFF:** Benefits result from using the towed sled as a source for determining whether contractor payment is fair and equitable, in reducing the scope of the dredging project, in reducing prior survey time, and in validating acoustic surveys.

**PROGRESS TO DATE:** A towed sled has been developed and verified by field application that will track on a navigable depth at a constant fluid mud shear resistance (i.e., constant density for a given channel).

**FUTURE PLANS:** The towed sled is immediately available for production use by Corps field offices.

**PRODUCT:** A towed sled for fluid mud navigation channel surveys.

Teeter, A.M., 1992, "The Viscous Characteristics of Channel-Bottom Muds," Dredging Research Technical Notes DRP-2-04, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Teeter, A.M., 1992, "Evaluation of New Fluid Mud Survey System at Field Sites," Dredging Research Technical Notes DRP-2-05, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Bottom Characterization Using Multibeam Sonar

**PRINCIPAL R&D AREA:** Dredging, Construction, Operation

**PRINCIPAL INVESTIGATORS:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Waterways management requires a knowledge of the composition of bottom material to determine if a passable and stable channel can be maintained.

**OBJECTIVE:** To characterize the bottom material within and around a waterway, and to delineate areas of similar material, using data from existing multibeam sonar systems.

**OVERVIEW/APPROACH:** We are developing a technique for determining the bottom properties of deep and shallow ocean areas using the Navy's wide-swath multibeam Sonar Array Survey System (SASS). This technique is based on measurements of backscatter signal strength over a range of bottom incident angles. The bottom characterization algorithms should be adaptable to the waterways environment and to multibeam sonars already in use in these areas.

**IMPACT/PAYOFF:** Information on bottom characterization is useful in determining the best location for a waterway and the amount and type of material that needs to be moved to construct and maintain the channel. It also can be used to establish the stability of surrounding bottom areas which could shift material into the channel.

**PROGRESS TO DATE:** We are nearing completion of the development of an ocean bottom characterization algorithm which will identify the type of sediment across a sonar swath. Current models of the amplitude response of sonar system and the propagation path will make it possible to calibrate the measurement for classification on a rough scale of bottom type (silt, mud, sand, rock).

Satriano/Fusillo, Sonar

**FUTURE PLANS:** Improved system and propagation models combined with ground truth from dredge or core samples will result in fine scale characterization of the seafloor. Algorithms for determining the boundary of areas of a sediment type also will be developed.

**PRODUCTS:** The algorithms developed will be incorporated into the SASS system for testing against known bottom types. Several technical papers have been written and more are planned to present our results. Patents for the algorithms and techniques are under consideration.

**OTHER AGENCIES INVOLVED:** Naval Oceanographic Office

**START DATE:** 1991

**EXPECTED COMPLETION:** 1996

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Channel Depth Requirements for CVNs at Mayport and San Diego

**PRINCIPAL R&D AREA:** Dredging, Decision Support, Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Nuclear aircraft carriers are being considered to be home based at ports with shallow entrance channels. What is the best depth to dredge the entrance channels to these ports?

**OBJECTIVE:** The objective was to determine the depth of the entrance channel that provided the maximum amount of port access with the least amount of required dredging.

**OVERVIEW/APPROACH:** Using the tide range, ship static draft, underway squat for a range of speeds, and motion transfer functions, the risk of touching the net effective channel depth for a range of project depths is generated. The results of this risk analysis are combined with the wave climatology in the area of the channel to determine the number of days of accessibility the carrier would have to transit the channel safely. From this analysis, an optimum channel project depth can be determined.

**IMPACT/PAYOFF:** The optimum channel depth determined from this analysis is usually shallower than the conventional means of determining channel depth. This can translate into millions of dollars saved in dredging costs and dredge spoils placement.

**PROGRESS TO DATE:** The study for the port of Mayport has been completed and documented. The study for the port of San Diego is awaiting a wave climatology generated from measured wave data at Imperial Beach. Its expected completion date is sometime in June.

**FUTURE PLANS:** It is possible to apply this technology to any port and ships with controlling drafts. To date, there is no further plans to apply this technique to any other port.

Silver, CVNs

**PRODUCTS:** The basic product of this study is a report documenting both the procedure and the results. One report for each port is anticipated.

**OTHER AGENCIES INVOLVED:** The U.S. Army Corps of Engineers Wave Information Study (WIS) was used for the basic wave climatology for each of the ports. A separate climatology was required for San Diego because WIS did not have any accounting for waves generated in the southern hemisphere. Therefore a climatology using measured data was required to be generated. The motion transfer functions of the nuclear aircraft carrier were validated, under a separate program, at the Waterways Experiment Station Coastal Engineering Research Center's shallow water tank.

**START DATE:** 29 September 1993

**EXPECTED COMPLETION:** 30 June 1994

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES**

**PROJECT TITLE:** Hydraulic Design Guidance for Fluidizers

**PRINCIPAL R&D AREA:** Dredging, Construction, Operations,

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** When inlets or harbor mouths have shoaling problems, or downdraft beaches erode because of an interruption of longshore littoral processes, sand bypassing can mitigate these adverse effects. The quantity of sediment that a fixed bypassing plant can handle is limited by the amount of sand supplied by littoral transport. An eductor (jet pump) or submersible pump creates a crater of fairly limited extent, and an operator must wait until the crater refills with sand supplied by littoral processes before pumping again.

**OBJECTIVE:** Fluidization is a process in which fluid is injected into a granular medium (typically sand) causing the grains to lift and separate. The design objective for a fluidization system is primarily to create a trench of given cross-section and length. A properly designed fluidizer system developed for use in conjunction with a fixed slurry pump may create a long (typically 100- to 400-ft) trench that traps sand across a portion of the littoral zone, thus supplying additional slurry to the pump crater.

**OVERVIEW/APPROACH:** To obtain such a trench, complete fluidization must be achieved. Two basic parts of the design are the hydraulic aspect to attain full fluidization and a geometric element to obtain a desired trench geometry. Basic research has helped define these two crucial features, and design guidance has been developed. The fluidizer pipe hydraulic design begins by determining the trench size, length, cross-section, and location. Flow rate through the pipe is a function of pipe diameters burial depth, and sand size and permeability (which can vary by orders of magnitude for coastal sediments). Pressure head in the fluidizer pipe must supply the energy to deliver the flow rate per hole through the selected hole size. Hole size and spacing do not have a profound effect on fluidization. Recommended values are hole spacing of 1 to 2 in., and hole size of 1/8 to 3/16 in. The fluidizer pipe, thus, is a manifold whose function is to provide a uniform flow out of the holes. A 10- to 12-in.-diam pipe is a reasonable starting point for hydraulic design calculations.



McNair, Hydraulic

**Impact/Payoff:** The best use of a fluidizer pipe in sand bypassing is to increase the fluidized zone of a fixed bypassing system and, thus, increase the production of the plant. For channel maintenance, the trench created by removing slurry from the fluidized region above a fluidizer pipe can be used to stabilize and maintain a navigable channel. If the pipe is placed sufficiently deep or if two or more pipes are placed in parallel, the trench dimensions that can be achieved may satisfy the navigation requirements of small shallow-draft vessels.

**PROGRESS TO DATE:** Guidance has been developed based on laboratory and field tests for enhanced production of eductors by increasing material transport to the pump.

**FUTURE PLANS:** Hydraulic design guidance for fluidizers is presently available for application at jet pump field sites.

**PRODUCTS:** Improved guidance for the design of fluidizers to enhance production of eductors or submersible pumps.

Clausner, J.E., 1992, "Fluidizer System Design for Channel Maintenance and Sand Bypassing," Dredging Research Technical Notes DRP-3-09, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** FACILITIES - DREDGING

**PROJECT TITLE:** Water Injection Dredging Technology

**PRINCIPAL R&D AREA:** Dredging, Construction, Operations

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The Dredging Research Program's desire to investigate new dredging technologies led to the first large-scale demonstration of water injection dredging (WID) in the U.S. Conducted at two sites on the upper Mississippi River, the demonstration was a combined effort that involved the U.S. Army Engineer Waterways Experiment Station, two Corps districts, and two contractors. WID is based on a very simple concept: vessel-mounted pumps inject water directly into the sediment voids through low-pressure jets mounted on a long horizontal pipe. This fluidizes the sediment, creating a gravity-driven density current that can flow down very mild slopes. The density current transports shoal material to deeper water, where it can settle without impeding navigation, or be carried farther away by stronger natural currents.

**OBJECTIVE:** The primary objective of the WID demonstration was to verify the accuracy of the contractor's predictions on production rate, transport distance and direction, and suspended sediment distribution in the water column. The secondary objective was to determine if the technology worked in conditions found on the upper Mississippi River (moderate currents, medium-sized sand substrates, and two types of shoals typically found there--crossings and point bars). A third goal was to introduce the technology in an area with strong environmental concerns so that those concerns would be addressed during the demonstration.

**OVERVIEW/APPROACH:** Regular coordination with Federal agencies (U.S. Fish and Wildlife Service, and U.S. Environmental Protection Agency) and resource agencies from Wisconsin and Minnesota was conducted throughout the planning process and during demonstration. The agencies were uncomfortable with the limited data available on suspended sediment levels and sediment transport distances. Gulf Coast Trailing designed and constructed a water injection dredge which was not self-propelled. An operating crew of three was needed, and a pushboat requiring a crew of two was necessary. The contractor-predicted production rates, and sediment

## McNair, WID

transport distances and directions, were reasonably close to actual values. The actual values were lower than predicted as the result of differences between surveys used for estimating production and actual site bathymetry at the time of the operation. This demonstration of a patented WID technique new to the U.S. successfully met planned objectives. WID appears to have potential at other sites.

**IMPACT/PAYOFF:** Advantages of WID when compared to other methods of dredging include lower cost for mobilization/ demobilization, quicker response time for project start-up, potentially lower operating cost, potentially higher production rates than dredges with comparable horsepower, and therefore potentially quicker project completion time. Because the injection head merely rides on the surface of the sediment as opposed to actively digging, WID allows safer operations with reduced chance of damage to docket pipelines, etc. Restrictions on navigation are much lower with WID because of the absence of discharge pipelines and spuds. Because the dredging equipment is simple to operate with minimal crew or other support, and because there is no need to actively transport the dredged material to a placement site, WID offers a potentially low-cost alternative to traditional dredging for appropriate locations.

**PROGRESS TO DATE:** Water injection dredging (WID) equipment has been adapted and demonstrations successfully conducted on the Mississippi River.

**FUTURE PLANS:** WID is a patented process with Gulf Coast Trailing being the U.S. licensee available for contract application of the process to appropriate Corps navigation dredging projects.

**PRODUCT:** Technology for conducting water injection dredging in presence of mild natural currents or slopes.

Clausner, J.E., Sardines, T., Krumholtz, D., and Beauvais, C., 1993, "Water Injection Dredging Demonstration on the Upper Mississippi River," Dredging Research Technical Notes DRP-3-10, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA: FACILITIES-DREDGING**

**PROJECT TITLE:** Dredged Material Open Water Disposal Site Management

**PRINCIPAL R&D AREA:** Dredging, Management Analysis, Inspection Operations, Decision Support, Management Analysis, Inspection

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Open water sites for placement of dredged sediments are located and managed to facilitate necessary dredging and the subsequent placement of the dredged sediments while minimizing potential adverse impact to human health and the aquatic environment. Continued use of aquatic sites for placement of dredged sediments depends on the perception of how well the USACE management policies and practices actually protect human health and the environment.

**OBJECTIVE:** The USACE approach to managing open water sites focuses on providing all necessary information for site managers to make informed decisions. The Corps must ensure that the substantive topics covered by over 30 Federal environmental laws and Executive Orders are properly addressed. It is necessary to develop formal detailed guidance which is presently lacking on many of the topics that are part of the disposal site management process. Another major objective of this research project is to provide an overall framework for applying the tools refined and developed in the Dredging Research Program.

**OVERVIEW/APPROACH:** A written, site-specific management plan can greatly facilitate management action over the extended use of the placement site. Monitoring is an essential component of the management plan. Sediment testing and evaluation must be performed to determine whether or not the sediment is suitable for open water disposal. The product from this Dredging Research Program research is comprehensive guidance for developing and implementing effective monitoring and management plans for dredged material open water disposal sites.

McNair, Open

**IMPACT/PAYOFF:** Effective site management can provide numerous benefits. The principal benefits are derived through ensuring the long-term availability of the placement site: potential project delays are avoided, the costs of identifying and designating or specifying an alternate site are saved, and potential increases in transportation costs or other costs relative to alternative sites are avoided. Effective site management also can increase regulatory efficiency, assure compliance with applicable Federal statutes and regulations, reduce conflicts with other uses of the aquatic environment, minimize adverse environmental impact, assure maintenance of safe and efficient navigation, optimize site use, and ease public concerns regarding aquatic placement of dredged material.

**PROGRESS TO DATE:** Comprehensive guidance has been developed for an effective site-specific management plan, including monitoring rate and placement of sediments, biological resource determination, and sediment testing and evaluation.

**FUTURE PLANS:** Management guidance is being consolidated by Corps Headquarters, and will be subsequently disseminated to field offices.

**PRODUCT:** Guidance for effective management of dredged material open water disposal sites to ensure long-term availability of the site, and assure compliance with applicable regulations.

Lemlich, S.K., Clausner, J.E., Pankow, V.R., Rosati, J. III, and Wright, T.D., 1992, "Corps of Engineers Dredging Data Management Related Software," Dredging Research, Vol. DRP-92-3, pp. 1-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Walls, B.E., Lemlich, S.K., Wright, T.D., and Mathis, D.B., 1994, "Open Water Placement of Dredged Sediment: A Framework for Site Management," Dredging Research Technical Notes DRP-5-(draft), U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**EXPECTED COMPLETION:** FY 94

## TECHNICAL SESSION SUMMARY 3C: VESSELS/EQUIPMENT & HUMAN INTERACTION II

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**Topic Statement**

**TOPIC AREA: VESSELS/EQUIPMENT**

**PROJECT TITLE:** Shipboard Piloting Expert System (SPES)

**PRINCIPAL R&D AREA:** Artificial Intelligence, Sensor Integration

**PRINCIPAL INVESTIGATOR**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Too many groundings and collisions.

**OBJECTIVE:** Provide decision support, recommendations and alternative courses of action to ship pilots and navigation officers operating in harbors and harbor approach areas.

**OVERVIEW/APPROACH:** A prototype expert system which utilizes real-time operational data and knowledge from ship pilots, rules of the road, and chart data bases, has been developed for transiting the Port of Valdez. This software system has been implemented within an Integrated Bridge System and installed aboard the tanker, SEA-RIVER BENEZIA.

**IMPACT/PAYOFF:** Reduction in the number of collisions/groundings, fewer oil spills, and a cleaner environment.

**PROGRESS TO DATE:** The Shipboard Piloting Expert System prototype has been fully developed and integrated within a commercial navigation system aboard ship. The software has been validated and the system is currently undergoing a shipboard evaluation (funded by the Coast Guard) to determine the operational benefit of the system versus a comparable system without the SPES. This evaluation is expected to be completed by the end of the year.

**FUTURE PLANS:** The work still remaining relates to commercialization of this technology. This includes converting the SPES software to a microcomputer environment, creating standard software to enable the SPES to be integrated with various navigation systems, and building additional knowledge bases for other ports.

**PRODUCTS:** SPES Final Report (DRAFT, expected completion 7/94)

Dumbleton, SPES

**RESEARCH PAPER:**

Grabowski, Martha and Sanborn, Steve, Nov. 1992, "Knowledge Representation and Reasoning in a Real-Time Operational Control System: The Shipboard Piloting Expert System (SPES)," Rensselaer Polytechnic Institute.

**OTHER AGENCIES INVOLVED:** Coast Guard, NOAA

**START DATE:** FY 1989

**EXPECTED COMPLETION:** FY 1996



**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** VESSELS/EQUIPMENT

**PROJECT TITLE:** Differential GPS Survey and Dredge Positioning System

**PRINCIPAL R&D AREA:** Dredging, Operations, Navigation

**PRINCIPAL INVESTIGATOR:**

**NAME:** Mr. E. Clark McNair, Jr.

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The need for a more accurate positioning system based on GPS carrier signals for Corps hydrographic surveying and dredging activities became apparent in recent years. The Corps conducts condition surveys on a routine basis to identify channel obstructions. If dredging is required to clear a channel obstruction, the Corps often contracts this work. A typical scenario is for the Corps to perform a hydrographic survey before the work is performed to identify to the contractor the specific material to be removed. After the work is completed, the Corps performs a contract payment survey. The current accuracy standard used for contract payment is 3 m horizontal and 0.2 m vertical.

**OBJECTIVE:** The Corps has been developing a GPS carrier phase based positioning system for hydrographic surveying and dredging since the beginning of the Dredging Research Program. This system provides real-time 3-D positions with horizontal and vertical accuracies better than 4 in. (10 cm) over ranges up to 20 km from a single reference station.

**OVERVIEW/APPROACH:** The project has passed from concept development through feasibility studies, system analysis, resolution of carrier ambiguities on-the-fly (OTF), to final system integration. Testing of the system has been performed under varying operating conditions to evaluate the limits of OTF ambiguity resolution for precisely positioning moving platforms. Tests have shown this system is capable of 1-3 cm in all three dimensions. This technology will have a great impact on both surveying and dredging. This particular system is robust, reliable and easy to use, and has surpassed its original design goal specifications. The system can be used today for applications that require real-time centimeter horizontal positioning. It also is a valuable engineering tool for those operations where post-processing data will suffice. Tests have been conducted onboard the USACE hopper dredge Essayons in ocean waters that provided up to 4.5 m swells. In reality, it has already been demonstrated that real-time OTF is as easy to provide as differential GPS within the current range limitations.

McNair, GPS

**IMPACT/PAYOFF:** Benefits will accrue from significantly more precise before- and after-dredging hydrographic surveys for dredging operations, and survey vessel and dredge positioning. Centimeter level accuracy in real-time 3-D is a reality.

**PROGRESS TO DATE:** A GPS carrier phase based positioning system for real-time hydrographic surveying and dredging has been developed, and field tests aboard ocean-going hopper dredges show the system is capable of 1-3 cm in all three dimensions.

**FUTURE PLANS:** Real-time modeling of tides using on-the-fly (OTF) technology, and relating OTF vertical measurements to local datum used for dredging projects, will be completed by end of FY 94.

**PRODUCT:** A 3-D, 4-in. (10-cm) accuracy GPS system for dredging surveys and dredge positioning.

Wells, D.E. and Kleusberg, A., 1992, "Feasibility of a Kinematic Differential Global Positioning System," Technical Report DRP-92-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Frodge, S.L., Remondi, B.W., and Lapucha, D., 1994, "Results of Real-Time Testing and Demonstration of the U.S. Army Corps of Engineers Real-Time On-The-Fly Positioning Systems," Proceedings, Institute of Navigation 1994 National Technical Meeting, San Diego, California.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** FY 88

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT"**  
**Topic Statement**

**TOPIC AREA:** VESSELS/EQUIPMENT

**PROJECT TITLE:** GPS for Vertical Control of Hydrographic Surveys

**PRINCIPAL R&D AREA:** Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The accurate measurement of depths from a moving platform requires an accurate reference plane and knowledge of the instantaneous location of the depth measurement sensor with respect to that plane. The factors which might cause variations in the depth measurement sensor are vessel data draft, vessel settlement and squat, state of the tide, density of the surface water and vessel response to waves on the air/sea interface and to waves on subsurface density interfaces as well as localized topograph obstructions to the water currents. This problem is now addressed by several sensors which must all be accurately functioning in order to vertically place the measured depths with regard to the reference plane. The long term Waterways Management issue is timely and accurate hydrographic survey data.

**OBJECTIVE:** The Hydrographic Ground Truthing Experiment is comprised of a series of field experiments to be conducted during the summer of 1992, 1993, and 1994 (HYGRO '92, HYGRO'93, and HYGRO'94). The experiment is an international effort sponsored by the Canadian Hydrographic Survey and led by the Ocean Mapping Group at the University of New Brunswick, Canada. HYGRO '92 and HYGRO '93 were fully successful in meeting their specific objectives.

The C&GS was a major participant in HYGRO '93, which included the primary objective to characterize the accuracy and precision of a SEABAT-9001 short range multi-beam bathymetric sonar. A secondary C&GS objective for HYGRO '93 was to take high quality dual frequency phase track GPS measurements from a single shipboard antenna for correlation with vessel motions in the seaway. The motions of concern were represented both in the vertical and horizontal planes. This basically proved the feasibility and high probability of success for the proposed HYGRO '94 work.

The important difference between the completed HYGRO '93 and the planned HYGRO '94 is that the former two established ground truth relative to the local geoid, whereas HYGRO '94 will

## Huff, GPS

establish ground truth relative to GPS vertical reference. This provides the opportunity for C&GS to extend the GPS observations on the vessel to multiple shipboard antennas which will provide the necessary data to extract the height of the vessel sounding transducer in the GPS reference frame. The seabed, as remotely measured with acoustics, can then be placed directly in the GPS reference frame regardless of the stage of tide in the survey area. Knowledge of the local chart datum in the GPS reference frame will allow the survey depths to subsequently be correctly placed on chart datum. This would potentially remove some requirements for tidal observations during survey operations and remove some of the errors associated with the present practice of "tidal zoning."

**OVERVIEW/APPROACH:** The advancing state-of-the-art in applications for GPS is approaching the capability to position a shipboard GPS receiving antenna with an accuracy of 1 to 2 centimeters in the vertical within several kilometers of a shore based GPS receiving antenna. This requires on-the-fly ambiguously resolution software and dual frequency phase tracking GPS receivers which are both presently available. It remains to be conclusively shown that depths vertically referenced to GPS can be accurately transferred to mean lower low water datum.

**IMPACT/PAYOFFS:** Increased productivity and improved accuracy of hydrographic surveys of ports/harbors/near shore coastal areas.

**PROGRESS TO DATE:** The activities necessary to conduct the HYGRO '94 experiments have been planned and funds sought.

**FUTURE PLANS:** To conduct a series of joint observations on NOS hydrographic platforms using both the classic and the GPS solution to vertical referencing. Based on those, practical operational results would establish plans for an orderly acquisition of equipment and a transfer to the new technology.

**PRODUCTS:** (reports, publications, inventions) N/A

**OTHER AGENCIES INVOLVED:** USACE

**START DATE:** FY 94

**EXPECTED COMPLETION:** FY 96

**FEDERAL WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
**"WATERWAYS MANAGEMENT-A PARTNERSHIP IN GOVERNMENT**  
**TOPIC STATEMENT**

**TOPIC AREA:** VESSELS/EQUIPMENT

**PROJECT TITLE:** Saint Lawrence Seaway, Differential GPS Buoy Positioning System

**PRINCIPAL R&D AREA:** Operations, Navigation

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** The differential GPS (DGPS) buoy positioning system is important to the Saint Lawrence Seaway Development Corporation (SLSDC) because of the seasonal climatic conditions along the Saint Lawrence River. At the end of each shipping season, in the late fall or early winter, SLSDC must remove from the river about 150 floating navigation aids so that they will not be damaged or destroyed by ice. Then in the spring, the buoys are redeployed by using horizontal sexton measurements to determine its proper location. This is a time consuming and costly procedure, and it is highly dependent on clear weather and landmark sighting geometry. In the spring of 1993, however, buoys were deployed rapidly and accurately using DGPS.

**PROGRESS TO DATE:** The Volpe Center designed and developed a unique system, including a computer graphical display, which combines inputs from a DGPS receiver on the buoy tender and the shipboard gyroscope to provide steering and distance information to the exact location where a particular buoy is to be placed. In addition to displaying current vessel location, as well as range and bearing to target, the buoy positioning also is responsible for database managements, log generation and data communications. The initial DGPS buoy positioning software was completed in February 1993 and the final operational system was delivered in March 1994.

Another key component of the DGPS buoy positioning project was the establishment of a differential base station at the Eisenhower Lock in Massena, NY. It was necessary to set up a base station because U.S. Coast Guard radiobeacons with DGPS corrections will not be in place on the Seaway until 1996. The location of the base station GPS antenna was carefully surveyed so that errors in receiver derived positions can be calculated. It is these errors that are converted to differential corrections which are transmitted by a cellular data link, to the GPS receiver on the buoy tender. The accuracy of this DGPS system is better than 5 meters, which is well within

## Chin, Hung, DGPS

to differential corrections which are transmitted by a cellular data link, to the GPS receiver on the buoy tender. The accuracy of this DGPS system is better than 5 meters, which is well within the Seaway requirement of 50 feet.

**FUTURE PLANS:** The present DGPS buoy positioning system uses a cellular telephone data link to transmit differential GPS corrections to the buoy tender. The United States Coast Guard and the Canadian Coast Guard are planning to collaborate in 1996 on the installation of marine radiobeacons to provide differential GPS coverage for vessels in the Saint Lawrence Seaway. With the addition of a DGPS marine radiobeacon receiver, the current DGPS buoy positioning system employed by SLSDC can accommodate both data communication modes. The Volpe Center has developed a computer simulation model for predicting the propagation characteristics of radio signal in the marine radiobeacon band, and it will be used to determine the area of coverage for proposed radiobeacon sites.

**START DATE:** November, 1992

**EXPECTED COMPLETION:** April, 1994

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**Topic Statement**

**TOPIC AREA:** HUMAN INTERACTION

**PROJECT TITLE:** Evaluating the Environmental Impacts of Navigation Traffic on the Upper Mississippi River System (UMRS)

**PRINCIPAL R&D AREA:** Operations and Other: Environmental Impacts, Hydrodynamic Modeling, Sedimentation Modeling, and Tow-Induced Current Modeling

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** A comprehensive evaluation methodology is needed so the Corps of Engineers (CE) can adequately address the impacts of increased navigation traffic over the next 50 years on the aquatic ecosystem of the Upper Mississippi River System (UMRS). Both long and short term effects are of concern for habitat in the main channel and channel borders, around islands, in backwater areas, sloughs, erosion of island and banks, secondary channels, and increased sedimentation caused by navigation.

**OBJECTIVE:** The objective of this study is to develop a system of computational tools and integration techniques to assess the impacts of increased navigation traffic on the UMRS aquatic ecosystem. The modeling system will aid the design of required mitigation measures.

**OVERVIEW/APPROACH:** This study has been very carefully designed to create a user-friendly working environment. As presently envisioned there will be six interrelated tasks:

**TASK 1 - Geomorphic Classification Scheme:** The purpose of this task will be to develop and implement a geomorphological classification scheme for the UMRS. This information is required to select representative study sites and provide a basis for extrapolating impacts predicted on a subset of reaches to the entire system.

**TASK 2 - 2D Refined Modeling:** This modeling will focus on numerically predicting the detailed impacts resulting from increased tow traffic. Multi-dimensional, adaptive hydrodynamic and sediment transport modeling will be employed in the main channel and side channels; one-dimensional approaches may be employed in the backwater areas. This task will include integration of hydrodynamic models with the results of near-field, physical forces modeling being conducted in a complimentary research investigation.

Holland, UMRS

**TASK 3 - System Modeling:** This task will provide a comprehensive model of systemic impacts of increased navigation traffic on the UMRS, and will be used to provide the necessary boundary conditions for the 2D refined modeling task.

**TASK 4 - Model Integration:** This task will provide the glue that holds the overall modeling approach together by providing a means to implement very efficiently the use and post-process data from both the systems and refined modules. This task will also provide the necessary computational linkages to ecological modules being developed in complementary research efforts.

**TASK 5 - Verification/uncertainty:** An essential part of any study is verification. This task will isolate techniques to insure the models adequately represent the prototype. A part of this effort will be devoted to quantifying uncertainty in model predictions as a prelude to full system risk assessment.

**TASK 6 - Sediment Modeling:** Tow induced resuspension and bank effects are critical in a comprehensive understanding of the impacts of increased navigation traffic. Quantitative methods to model these impacts will be developed based on the extensive sediment transport modeling capabilities available at WES.

**IMPACT/PAYOFF:** Through a system of computational tools and integration techniques engineers will be able to assess the impacts of increased navigation traffic on aquatic ecosystem and design of required mitigation measures.

**PROGRESS TO DATE:** An implementation scheme has been developed for the classification scheme (TASK 1) and the scope of work for the other tasks has been initiated.

**FUTURE PLANS:** Conduct the listed task area studies over the next 30 months. Develop the modeling system and apply it to hundreds of scenarios for the UMRS. Aid decision makers in final mitigation planning as appropriate.

**PRODUCTS:** None as yet; this is a new start.

**OTHER AGENCIES INVOLVED:** St. Louis, St. Paul, and Rock Island Districts and National Biological Survey's Environmental Monitoring Technical Center

**PROJECT NAME:** Upper Mississippi-Illinois River Navigation Effects Study

**START DATE:** FY 93

**EXPECTED COMPLETION:** FY 96



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**Topic Statement**

**TOPIC AREA:** VESSELS/EQUIPMENT & HUMAN INTERACTION

**PROJECT TITLE:** Innovative Inspection Procedures/Techniques

**PRINCIPAL R&D AREA:** Develop Methods and Identify Equipment for Coast Guard Marine Inspectors That Will Make Vessel Inspections More Efficient and Safer.

**PRINCIPAL INVESTIGATOR:**

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**PROJECT DESCRIPTION**

**PROBLEM STATEMENT:** Due to budget, time and paperwork constraints, CG inspectors are spending less and less time inspecting vessels. They are also sometimes putting themselves in potentially dangerous situations.

**OBJECTIVE:** Technology has improved visual and nondestructive methods of inspection. This project will identify equipment and/or procedures that may increase the efficiency and safety of the inspection process, especially for large tankships.

**IMPACT/PAYOFF:** Safer vessels, less likelihood of environmental damage, less impact on vessel schedules.

**PROGRESS TO DATE:** The first set of tests has identified low-technology held gear such as better lighting which has the potential to increase visibility and safety within confined spaces. Equipment has been screened in initial testing and is currently being evaluated by Coast Guard field units.

**FUTURE PLANS:** Test some higher technology devices which may allow scanning of the vessels, especially advanced nondestructive evaluation methods such as laser scanning, microwaves and remote cameras.

**PRODUCTS:** Two reports containing recommended equipment/procedures by the end of FY 95.

**OTHER AGENCIES INVOLVED:** None

**START DATE:** 1992

**EXPECTED COMPLETION:** 1995

## APPENDICES

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**APPENDIX A**  
**1994 WATERWAYS MANAGEMENT R&D CONFERENCE**  
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**WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE**  
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## **APPENDIX D**

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Scott Air Force Base (USAF)

Saint Lawrence Seaway Development Corporation (SLSDC)

Tennessee Valley Authority (TVA)

U.S. Army (USA)

    Cold Regions Research & Engineering Lab (CRREL)

    Corps of Engineers (USACE)

        Waterways Experiment Station (WES)

U.S. Coast Guard (USCG)

    Coast Guard Academy (CGA)

    Headquarters (HQ)

    Research & Development Center (R&DC)

    District One

U.S. Navy (USN)

    Naval Command Control & Ocean Surveillance Center (NCCOSC)

    Naval Facilities Engineering Command (NAVFAC)

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## **APPENDIX F PRESS RELEASES**

For IMMEDIATE RELEASE  
June 7, 1994

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### **Establishing Effective Research Partnerships in Government: Goal of Federal Waterways Management R&D Coordination Conference Hosted by U.S. Coast Guard Academy in New London, Connecticut, June 7-9, 1994**

U.S. Coast Guard Academy, New London, CT--June 7, 1994.

The 2nd Federal Waterways Research & Development Coordination Conference was convened today by Rear Admiral P.E. Versaw, Superintendent of the Coast Guard Academy. The nation's waterways are an integral part of commercial shipping in the United States, and Federal management of these waterways is essential to regulating the increasing traffic in an effective and safe manner. During the three-day event at the Academy, technical sessions will focus on Information Systems for Management, Information Systems for Navigation, Facilities--General and Dredging, and Vessels, Equipment, and Human Interaction. Seventy-five topics were submitted for presentation in the technical sessions.

Rear Admiral Versaw welcomed the Federal agencies taking part in this collaborative conference and defined the motivations and goals for the three-day event, hosted by the U.S. Coast Guard Office of Navigation Safety and Waterway Service and the Office of Engineering and Logistics Support. The U.S. Coast Guard's R&D Center is the principal coordinator of the conference.

The purpose of the conference was to identify the research goals and objectives of each agency, and the potential collaborative research projects, as they relate to the management of our nation's waterways. The importance of the conference, noted Admiral Versaw, was in the collaborative potential of the research work each agency is undertaking.

Some of the challenges put forth to the attendees are:

What are the common areas of research and development that are prime opportunities for effective collaboration? Where are agencies overlooking existing potential for effective collaboration? What issues are impeding the process? What are the priorities of action to improve the efficiency and safety of the waterways from a system-wide perspective?

The agencies and presenters in attendance were U.S. Coast Guard Rear Admiral William J. Ecker, Chief, Office of Navigation Safety and Waterway Services, U.S. Coast Guard; U.S. Army Corps of Engineers, Dr. William E. Roper, Director of R&D, Civil Works; Maritime Administration, Mr. Paul Mentz, Director, Office of Technology Assessment; U.S. Navy, Naval Facilities Engineering Command, Andrew Del Collo, Assistant Director for R&D; and the National Oceanic and Atmospheric Administration, National Ocean Service, Dr. W. Stanley Wilson, Assistant Administrator for Ocean Services & Coastal Zone Management.

In the June 7th opening of the conference, agency presenters summarized their current work and how it relates to the objectives and overall mission of their particular agency. It was noted that there are ongoing intra-agency collaborations such as surveying, electronic charting, marine data electronic bulletin board systems and dredging operations. The theme of "a partnership in government" underlies the entire Waterways Management R&D Coordination Conference with a goal of continuing to establish effective research partnerships among federal agencies.

Technical sessions for the first day of the conference focused on how waterway management is benefiting from the use of Information Systems. In another session, new technology, findings and management of waterway facilities such as harbor structures and other water management installations were presented. A third session explored the technology and issues involved in the relationship of Vessels, Equipment, and Human Interaction.



FOR RELEASE June 8, 1994

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**Federal Waterways Management Conference  
Tours U.S. Coast Guard Academy's R&D Center**

U.S. Coast Guard Academy, New London, CT--June 8, 1994.

The 2nd Federal Waterways Research & Development Coordination Conference continued today at the U.S. Coast Guard Academy. Invited attendees from various federal agencies toured the U.S. Coast Guard Academy and the Research and Development Center. The tour was part of the conference, the purpose of which is, in part, to identify the collaborative potential of the research work each federal agency is undertaking. (The U.S. Coast Guard's R&D Center is the principal coordinator of the conference.)

The tour included the Academy's Tow Tank and Wave Tank. These research operations are scale models of ocean conditions where vessel and facilities testing can be performed, simulating an infinite number of variables from wave and wind action to vessel type and size. The academy is one of the few places in the world where these facilities are in place and in use.

Further stops on the tour included the CAD Lab for computer-assisted-design, the Electronic Engineering Lab and the Bridge Simulator. The tour provided attendees with the opportunity to see how the Academy's operations might operate as collaborative tools in their own research. The Federal Agencies in attendance are the U.S. Army Corps of Engineers, the Maritime Administration, the U.S. Navy, Naval Facilities Engineering Command, and the National Oceanic and Atmospheric Administration (NOAA), National Ocean Service. Attendees also gained insight into how USCG cadets are involved with simulated events as part of their training.

During this ongoing three-day event at the Academy, technical sessions will focus on Information Systems for Management, Information Systems for Navigation, Facilities--General and Dredging, and Vessels, Equipment, and Human Interaction.

Today's technical sessions included how technology and Information Systems are being applied in navigation, including ECDIS (Electronic Chart Display Information Systems), a recent development of research. Other technical sessions focused on dredging, a vital function to maintain waterway efficiency, and a continuing discussion on the technology, training and other issues involved in the relationship of Vessels, Equipment and Human Interaction.

The theme of "a partnership in government" underlies the entire conference with a goal of continuing to establish effective research partnerships among federal agencies.

FOR RELEASE June 9, 1994

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**Collaborating Federal Agencies Combine Efforts  
at Waterways Management Research Conference  
at U.S. Coast Guard Academy**

U.S. Coast Guard Academy, New London, CT--June 9, 1994.

The 2nd Federal Waterways Research & Development Coordination Conference concluded today at the

U.S. Coast Guard Academy by examining how as federal Agencies, they can make their research more efficient, more widely usable among agencies, and more directed at common areas of need in Waterways Management. (The nation's waterways transport a significant portion of U.S.commerce and trade.)

In the previous two days of the conference, attendees from the federal agencies (U.S. Army Corps of Engineers, the Maritime Administration, the U.S. Navy, the National Oceanic and Atmospheric Administration, and the U.S. Coast Guard were exposed to the direction and goals of research being performed by each agency. These final working sessions cover each of the technical areas of Information Systems for Management, Information Systems for Navigation, Facilities--General and Dredging, and Vessels, Equipment, and Human Interaction.

Today, the attendees, presenters, and co-leaders of the conference face the challenge of identifying collaborative research opportunities and approaches necessary to implement inter-agency action. To accomplish this consensus, the conference is using a technique employed in many businesses and corporations: Total Quality Management facilitators. The purpose of these highly trained people is to help a group of diverse individuals focus on specific goals and the strategies to achieve them. The facilitators have the ability to keep people on track, with common goals continuously maintained within the framework of the discussions.

The overall goal is to improve Federal Waterways Management and Research while utilizing the government's resources and highly skilled researchers in a responsible, focused, coordinated plan which is significantly more effective for the nation and all the participating agencies.

Following the working sessions, conference management leadership and participants met in a plenary session which will result in proceedings assembled and distributed to all participants and the Federal Agencies.

## **APPENDIX G**

# **WATERWAYS MANAGEMENT R&D COORDINATION CONFERENCE EVALUATIONS**

From the 72 participants in the Waterways Management R&D Coordination Conference who received evaluation forms to complete on the June 7-9, 1994 event, 14 persons returned comments. Below the Steering Committee's comments are included with the others'.

Areas of evaluation included Agency Overviews, Topic Statements, Working Groups, Tours of Coast Guard Academy, R&D Center, Registration Process, Accommodations, Other.

### **OVERALL**

In general, comments indicated the effectiveness and usefulness of the Agency presentations, the good variety of Topic Statements, the need for focus on Topic Statements to be presented. (NOTE: USACE submitted 36 of the original 76 Topic Statements.)

Questions were raised about how to organize and predict attendance for working groups.

Tours of the R&D Center and Coast Guard Academy were rated excellent as was the ice-breaker social event.

Attendees suggested a Washington-based site in the future to reduce travel costs and increase attendance on the first and last day of the program.

Specifically, agency presentations drew applause of "informative," "raised appropriate issues," "very useful," "effective."

The purpose of the conference was accomplished: to identify R&D cooperative opportunities.

### **AGENCY OVERVIEWS—OPENING PLENARY**

Agency heads presented helpful perspectives of their organizations' roles in R&D.

### **TOPIC STATEMENTS**

How to focus quality Topic Statements for presentation ranged from a recommendation for the Steering Committee's call for papers to include 1) cooperative activities in progress, 2) proposed cooperative efforts, to (3) a suggestion of the Steering Committee's selected focus areas rather than general areas. The leading suggestion was to feature presentations where cooperative projects are in process, and to print the other topic statements indicating what is happening in research.

Through the self-selection process, the Technical Sessions covering Information Systems for Navigation were the best attended.

## **TOPIC STATEMENTS (cont'd)**

Several persons mentioned that too many Topic Statements were narrow in interest. Some Corps presentations were not of interest to other agencies. Shallow-draft (towboat) topics/issues should be dropped. Other attendees liked the breadth of the topics.

The question was raised, "What specific areas were not included but should be in the future?" The Navy and Coast Guard are working on human factors R&D, and should present in the future their extensive human factors activities. The Navy branches should present their simulation activities.

Participants liked having the book of Topic Statements overviews for reference during the presentations. Investigators' names and addresses were beneficial. E-mail addresses should be added in the future.

## **TOPIC STATEMENTS SCHEDULING**

Scheduling recommendations were "more time needed for individual presentations"; 20 minutes per speaker including questions and answers, with session organizers/moderators to hold to the schedule as advertised may be appropriate.

A consensus on scheduling indicated the need for scheduled presentations. Presentations with technical content announced in time slots would be predictable so that attendees can walk from session to session to hear particular speakers and topics.

## **WORKING GROUPS**

Participants commented that some working group sessions were scheduled but never happened, and that changing from scheduled rooms was a concern. As a reminder, one participant encouraged working group facilitators to complete their work at the end of each session and not wait until the end of the conference, since some people had to leave early.

Discussions, which occurred during the working group session on the last day were called "good exchanges," and opened doors for cooperation.

## **CLOSING PLENARY SESSION**

Scheduling of the final plenary session conflicted with early departures scheduled because of least expensive flights.

## **ACCOMMODATIONS**

Benefits included the extensive bus shuttles; so much so that one participant indicated that pre-conference announcements might have indicated no need to rent cars.

Accommodations were very adequate both with housing and conference facilities, considering the water problem. Congratulations were extended to the Coast Guard Academy.

## **ACCOMMODATIONS (cont'd)**

A conference "site should be nearer an airport," was noted. Site comments included "Federal conferences will draw greater attendance if held in the Washington, D.C. area. Travel outside Washington D.C. is expensive for D.C. Headquarters personnel."

"Conference-arranged hotel rates were higher than government contract rate". (NOTE: The New London Holiday Inn had allocated all of its government-rate rooms, according to policy).

## **REGISTRATION**

Registration comments included: "Smooth registration," "well organized," "easy."

"Preregistration was a good idea."

(NOTE: 15 pre-registrations) "...good to have a professional involved in the handling of the conference details.

## **ACTIVITIES**

The ice-breaker social the first evening on campus was a success and enjoyable. The casino activity off-campus was not well-attended because the time commitment was too long after the tours.

## **LESSONS LEARNED**

### **Topic Statements Scheduling**

Group up to 6 presenters followed by 15-20 minutes discussion, consensus discussion and any commitment to future cooperative efforts.

### **Topics**

The steering committee should call for papers which are relevant to multi-agencies, and identify the specific topic statements sought. 1995 examples: Hydrographic Survey Data, NOAA & USACE; Effective Channel Design; Houston Ship Project-Prototype System.

Tours Guides should keep tour stops on schedule as printed.

### **Communications**

Audiences for press releases are legislators and agencies' employees--military and civilian. Promote the written Summary of the Federal Waterways R&D Coordination Conference.

COMMENT: The 1st Federal Navigation Waterways R&D Conference was informational.

The 2nd Federal Waterways Management R&D Coordinating Conference identified cooperative opportunities in R&D.

The 3rd Federal Waterways R&D Coordination Conference, hopefully, will bring commitment to cooperation among agencies in R&D.

## **APPENDIX H RECOMMENDATIONS FOR ACTION**

The Federal Waterways R&D Coordination Conference facilitators and Co-Leaders identified issues, which through recommendations will bring solutions, resolutions, and commitment for action.

### **Information Systems-Navigation Sessions:**

1. The Maritime Administration plans as a result of the presentations to investigate a joint project with the National Ocean service involving PORTS--Physical Oceanographic Real Time System. Ask John Dumbleton (MARAD) and Wayne Wilmot (NOAA) what their interest is in PORTS. Howard Park (USACE) who knows REEGIS suggested the commonality of USACE and PORTS.
2. Convene a workshop on Real Time Data projects. RASTER nautical charts and the need for one format will be included. What is the value of RASTER? Limitations? What is the possible technology development within the RASTER data? Stan Alper (NOAA) will draft an agenda for consideration by the R&D Steering Committee at their next meeting. (Stan Alper, Larry Daggett, Margie Hegy, Fred Seibold, Andy Silver, Ric Walker)
3. Convene a Bulletin Boards Coordination workshop. Who should develop the coordinated bulletin board(s)? Manage/coordinate? Ongoing costs? Who should have access? Stan Alper will draft an agenda for consideration in fall 1994 by the R&D Steering Committee, and also will consult David Enabnit, and the Department of Transportation.
4. Request joint position paper from USACE and NOAA on issues of production and distribution of charts, efficiency in production (includes nautical charting, tide and current information.) Larry Daggett and Stan Alper will identify one person from each of their respective organizations, USACE and NOAA, to write the paper for the R&D Steering Committee and Interagency Committee.
5. Request information from USACE and CGR&D on the collection and consolidation of data formats, ongoing work on setting standards for data formats, generating data. What data can be generated with commonalities? What data can be collected, put in simulators, used for CG certification? How can we produce data on different formats for analyses approaches? What data dictionaries can be included? What will be the environmental constraints in the future? Talk to Steve Cobb (USACE). Larry Daggett (USACE) and Ric Walker (USCG R&DC) will prepare the paper.

6. Classify different areas of waterways to predict changes for future accident possibilities. Larry Daggett (USACE) is exploring accident history, actions the Corps is taking as potential for predicting oil spills (lock replacements, bridges, log performance data system). Try to involve the Navigation Data Center.

**Vessels, Equipment & Human Interactions Sessions:**

7. Explore further joint uses of the GPS and Differential GPS being put into operation by the USCG. Examples during 1994 included positioning buoys (USACE) and applications to hydrographic surveys (NOAA).

8. Explore the new cooperative project in which the National Ocean Service with the U.S. Army Corps of Engineers will augment the Coast Guard VTS system at Belgen Point, Staten Island, NYC, with current and water level measurement systems as extension of its PORTS--Physical Oceanographic Real Time System.

## **APPENDIX I ACRONYMS**

ACM	Articulated Concrete Mats
AEM	Airborne Electromagnetic
AIT	Automated Identification Technologies
ARMS	Acoustic Resuspension Measurement System
ATONIS	Aid to Navigation Information System
CEWES	Corps of Engineers' Waterways Experiment Station
CGA	Coast Guard Academy
CGR&DC	Coast Guard Research & Development Center
CPAR	Construction Productivity Advancement Research Program
CRREL	U.S. Army Cold Regions Research & Engineering Lab
DGPS	Differential Global Positioning System
DPR	Drilling Parameter Recorder
DRP	Dredging Research Program
DSS	Decision Support System
ECDIS	Electronic Chart Display and Information System
G-E	Coast Guard Office of Engineering, Logistics, and Development
GIS	Geographic Information System
G-N	Coast Guard Office of Navigation Safety and Waterway Services
ECS	Electronic Chart System
FE	Finite Element



FY	Fiscal Year
GPRA	Government Performance & Results Act
GPS	Global Positioning System
GPS ADS	Global Positioning System Attitude Determination System
IHO	International Hydrographic Organization
IMO	International Maritime Organization
ITV	In-Transit Visibility
IWR	Institute for Water Resources (U.S. Army Corps of Engineers)
LAN	Local Area Network
LOS	Line of Sight
MARAD	Maritime Administration
MIT	Massachusetts Institute of Technology
MOORSEL	Mooring Selection Program
MTMC	Military Traffic Management Command
NAVFAC	Naval Facilities Engineering Command
NCCOSC	Naval Command Control & Ocean Surveillance Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPR	National Performance Review
NSDI	National Spatial Data Infrastructure
NSWC	Naval Surface Warfare Center
OTF	Ambiguities on the Fly
PLT	Point Load Testing

PLUMES	PLUme Measurement System
PORTS	Physical Oceanographic Real-Time System
RCIP	River Confluence Ice Program
REEGIS	River Engineering & Environmental Geographic Information System
R&D	Research & Development
SDI	Spatial Data Infrastructure
SHOALS	Scanning Hydrographic Operational Airborne Lidar Survey
SLSDC	Saint Lawrence Seaway Development Corporation
SI	Silent Inspector
SSTFATE	Single Operation Short-Term Fate
T&E	Training & Education
TSC	(Volpe National) Transportation Systems Center
TVA	Tennessee Valley Authority
USACE	U.S.Army Corps of Engineers
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USN	U.S. Navy
USTRANSCOM	U.S. Transportation Command
WANDS	Waterways and Navigation Data Services
WES	Waterways Experiment Station (U.S. Army Corps of Engineers)
WID	Water Injection Dredging
WIS	Wave Information Study